ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	2 A
Geophysics and Geochemical Prospecting	9 A
Drilling	9 A
Production	11 A
Oilfield Development ...	15 A
TRANSPORT AND STORAGE ...	19 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	22 A
Distillation	22 A
Cracking	22 A
Alkylation	24 A
Isomerization	24 A
Chemical and Physical Refining	25 A
Special Processes	26 A
Metering and Control	27 A
Safety Precautions	27 A
Patents	27 A
PRODUCTS.	
Chemistry and Physics ...	30 A
Analysis and Testing ...	32 A
Gas	33 A
Gas Oil and Fuel Oil	33 A
Lubricants	35 A
Special Hydrocarbon Products	36 A
Derived Chemical Products ...	36 A
Miscellaneous Products ...	36 A
ENGINES AND AUTOMOTIVE EQUIPMENT	37 A
MISCELLANEOUS	39 A
BOOKS RECEIVED	41 A

AUTHOR INDEX.

The numbers refer to the Abstract Number.

Alexander, C. W., 79
Alexander, M., 124
Alexander, P. P., 121
Allison, A. P., 26
Amdur, J., 128
Amon, F. H., 121
Anderson, J., 121
Arbuthnot, C. E., 121
Archer, F. G., 57
Arend, A. G., 42
Armistead, G., 111, 112
Arnold, C. B., 121
Arveson, M. H., 121

Bailey, C. H., 168
Barr, V. L., 57
Bates, F. W., 70
Bates, R. L., 72
Beacon, G. B., 121
Beckelhymer, R. L., 27
Beilhars, C. F., 85
Bell, A. H., 68
Bevarly, H. W., 144
Blackburn, C. E., 60
Borden, J. L., 76
Bowden, R. H., 114
Brancker, A. V., 129
Bridgwater, R. M., 165
Brock, W. H. J., 66
Brown, R. W., 21
Bucher, J. E., 86
Buckley, S. E., 53
Burk, R. E., 121
Butcher, E. R., 121

Cadman, W. H., 148
Cantrell, T. L., 121
Carlson, H. A., 57
Carr, D. E., 121
Case, L. C., 58
Chambre, P., 151
Chase, C. L., 86
Cheney, M. G., 12
Chia-Chiao Lin, 151
Clarke, A. B., 125
Cole, V. B., 74
Conant, L. C., 13
Corbin, N., 124
Cortes, H. C., 11
Cox, B. B., 7
Cranke, W. S., 63

Daniels, L. G., 66
Davies, S. N., 14
Davis, D. M., 85
Dunlop, J. B., 121

Eardley, A. J., 37
Eargle, D. H., 13
Egloff, G., 124
Eilerts, C. K., 57
Elias, M. K., 23
Ellison, S. P., Jnr., 3
Estorff, F. E. von, 31
Evering, B. L., 121

Fairbridge, R. W., 2
Farley, F. P., 147
Fawcett, E. W. M., 121
Finley, W. L., 121
Flock, B. J., 108
Folkins, H. O., 121
Foster, A. L., 107, 113
Foster, S. W. G., 150
Frang, R. A., 121
Frantz, R. K., 115
Freud, M., 130
Frye, J. C., 23
Fugitt, Le Roy, 82

Garner, F. H., 125
Ginsburg, A., 115
Gollin, G. J., 137, 138, 139, 140
Gordy, Walter, 127
Green, A. D., 121
Grodzinski, P., 143
Griswold, J., 114
Guillemin, V., 52

Haensell, V., 121
Hagethorn, N. E. M., 131
Hardenberg, H. J., 73
Harkins, W. D., 122
Hastings, S. H., 121
Heath, W. A., 61
Helmers, C. J., 121
Heltzel, W. G., 94, 95
Hirschler, A. E., 123
Hoffmeister, W. S., 69
Hoge, A. W., 109
Holm, H. K., 121
Houlton, H. G., 144
Houndry, E. J., 121
Howes, D. A., 121
Hudson, L. C., 66
Huff, L. C., 121
Hughes, E. C., 121
Hull, W., 121
Hume, G. S., 87
Hunter, T. G., 125
Hurley, P. E., 121

Ipatieff, V. N., 110
Ipatieff, V. I., 121
Ivanovsky, L., 145

Jones, J. P., 121
Jura, G., 122

Karle, J., 126
Kastrop, J. E., 50
Kellett, J., 121
Kellogg, F. N., 48
Kennedy, H. T., 41
Kent, F. A., 121
Kirk, J. H., 121
Koester, E. A., 74
Krampert, E. W., 77
Krueger, M. L., 29
Kuhn, C. S., Jr., 121
Kurtz, S. S., Jr., 123

Lahee, F. H., 67
Lambert, H. W., 97
Landes, K. K., 5
Lane, S. C., 121
Lesser, M. A., 149
Littman, E. R., 121
Loesser, E. H., 122
Loetterie, G. J., 83
Loveley, H. R., 36
Lunts, D. M., 109

Maher, J. C., 17
Marisic, M. M., 121
Mark, F. L., 121
Marriott, R. H., 120
Marshall, E. T., 121
Mattox, W. J., 121
Matuszak, M. P., 121
Meyer, R. R., 121
Mills, F. W., 123
Mills, R. B., 99
Montgomery, P. A., 82
Moody, G. B., 71
Moran, T. G., 15
Monroe, W. H., 13
Murray, F. F., 43
Musselman, J. M., 121
Myers, C. L., 51
Myers, N. F., 121

McAllister, S. H., 121
McBain, J. W., 146
McNab, J. G., 121

Nelson, W. L., 96, 101, 102, 106, 134
Noll, H. D., 109
Norbisrath, H., 24
Norman, H. S., 93, 78, 121
Nottorf, H. A., 118

O'Kelly, A. A., 116, 121
Olcott, Perry, 80
Oppenheimber, V., 34

Patrick, C. W., 121
Peters, J. G., 121
Petry, T. A., 121
Phenix, B. C., 119
Pierce, J. A., 121

Pilz, G. D., 147
Pirson, S. J., 55
Prange, F. A., 167
Price, P. H., 9
Price, W. A., 23
Prouty, C. E., 28

Reed, L. C., 32
Reed, J. C., 30
Reeves, F., 89
Reynolds, J. J., 100
Richards, P. H., 146
Rittenhouse, G., 8
Roberts, T. G., 25
Robinson, D. Van, 69
Rocchini, A. G., 121
Rogers, D. T., 121
Rook, C. G., 103
Rose, G. F. R., 168
Ross, W. E., 121
Rueggeberg, W. H. C., 115

Sachanen, A. N., 116
Sadler, C. G. A., 120
Sandidge, J. R., 10
Schiller, H., 66
Schmerling, L., 110
Schulze, J. W., 135, 136
Schulze, W. A., 121
Schuppli, H. M., 40
Scott, F. L., 45
Scrafford, B., 84
Selfridge, F. W., 121
Seyfried, W. D., 121
Shabaker, H. A., 121
Shapiro, A., 66
Shelby, T. H. Jnr., 83
Shelton, J. S., 15
Sheppard, C. W., 1
Shoemaker, B. H., 121
Short, E. H., 47
Siskind, D. I., 44
Smith, A., 98
Smith, H. G., 121
Smith, R. V., 57

Spivey, R. C., 25
Steele, C. T., 121
Steinitz, E. W., 142
Stieltjes, F. H., 131
Stuart, A. H., 141
Suderman, A. W., 132
Sutton, F. A., 35
Sutton, M., 144

Taylor, H., 19
Thalmann, H. E., 33
Thomas, C. L., 121
Thomas, H. D., 29
Trimble, H. M., 132
Tsao, U., 121
Tucker, A. J., 46
Tyler, W. S., 121

Umbgrove, J. H. E., 39
Umbgrove, J. H. F., 4
Underwood, A. J. V., 104, 105
Upham. J. D., 121

Varentzov, V. P., 133
Ver Wiebe, W. A., 18

Waldschmidt, W. A., 16
Walters, R. F., 20
Walters, R. P., 38
Walton, P. T., 22
Warren, W. C., 24
Watson, C. W., 121
Weatherburn, A. S., 168
Weber, G., 56, 65
Weiss, F. T., 121
Wharton, J. B., 72
Whitehead, W. L., 1
Whitmore, F. C., 118
Williams, I., 121
Wilson, W. Kerr, 152
Woodford, A. O., 15
Woods, E. H., 86
Wredden, J. H., 145

Zobell, C. E., 6

Oilfield Exploration and Exploitation.

Geology.

1. Formation of Hydrocarbons from Fatty Acids by Alpha-Particle Bombardment. C. W. Sheppard and W. L. Whitehead. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 32.—This paper describes some of the results obtained to date in the American Petroleum Institute research project 43c, dealing with the possibility of a radioactive origin of petroleum.

Four members of the saturated fatty acid series were subjected to bombardment in turn from alpha-particles. The latter were obtained from capsules of radon gas, arranged in a suitable apparatus.

The experiments are described, and the products identified are listed, as far as they could be determined. E. N. T.

2. Submarine Slumping and Location of Oil Bodies. R. W. Fairbridge. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 84.—The author suggests that a study of submarine slumping effects may assist in the discovery and appraisal of oil prospects, The paleogeographical occurrences of slumping seem to have been an associated factor in oil formation. The Carpathian and Caucasus areas are cited as excellent examples of this phenomenon. E. N. T.

3. Conodonts as Palæozoic Guide Fossils. S. P. Ellison, Jnr. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 93.—80 Conodont genera are listed, with sketches and notes of their geologic time ranges. The use of conodonts as methods of stratigraphic identification are discussed, with particular reference to the Devonian. E. N. T.

4. Origin of Continental Shelves. J. H. F. Umbgrove. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 249.—Almost everywhere the real edge of a continent lies about 200 metres below sea-level. That is to say that the continents are bordered by shallow platforms, whose total area is about 10,000,000 square kilometres.

These continental shelves can be accounted for by spasmodic warpings having taken place along the continental border, causing submergence of the edges of the continents. It is suggested that the periodic action of sub-crustal convection currents may account for this phenomenon. E. N. T.

5. Porosity through Dolomitization. K. K. Landes. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 305.—A number of oilfields in the United States produce from locally dolomitized limestones. Notable examples are the Trenton field of Ohio and Indiana and the Adams and Deep River fields in Michigan. Previous theories advanced to explain the porosity due to locally dolomitized zones in limestones are inadequate. It is suggested that local diastrophism may have produced master fissures in the

limestones, and artesian currents circulated upwards from deeper dolomites into the limestones. These waters may have replaced some of the limestone by dolomite that is locally porous where there has been an excess of solution over precipitation. From the point of view of exploration, it is suggested that a dry hole in which the limestone samples contain more than average magnesium carbonate should encourage exploration laterally in the hope of finding true dolomites. E. N. T.

6. Studies on Redox Potential of Marine Sediments. C. E. Zobell. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 477.—The redox potential is a quantitative measure of the state of a reversible oxidation-reduction system. It is measured in volts and termed E_h, where

$$E_h = E_0 + 0{\cdot}03 \log \frac{(\text{Ox.})}{(\text{Red.})}.$$

In this equation E_0 and 0·03 are constants and (Ox.) and (Red.) are concentrations of the oxidized and reduced forms of the systems. When (Ox.) = (Red.), or when the system is 50% in the oxidized and 50% in the reduced states, $E_h = E_0$. Thus, E can be defined as the E_h of a reversible O/R system which is half reduced.

The redox potential is an expression of the reducing intensity or electron-escaping tendency of a system, which are distinct from the reducing capacity or poise of a system.

Techniques for estimating the redox potential and reducing capacity with indicator dyes are outlined, as well as electrometric methods. Accuracy of determination with marine mud samples is no greater than $\pm 0{\cdot}01$–$0{\cdot}05$ volts. The E_h of recent marine sediments varies between $+0{\cdot}350$ and $-0{\cdot}500$ volts, and the pH ranges from 6·4 to 9·5. Negative E_h values are characteristic of fine sediments, rich in organic matter and bacteria. Positive E_h values tend to occur in coarse, well-oxygenated material.

The study of the redox potentials of sediments may be of great significance in the problem of petroleum origin. E. N. T.

7. Transformation of Organic Material into Petroleum under Geological Conditions (The Geological Fence). B. B. Cox. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 645.—This outline summarizes the present position of the problem of petroleum genesis, which is being investigated under the American Petroleum Institute Fundamental Research Project No. 43.

The limiting conditions considered are those of marine environment, relatively low pressures and temperatures of formation, and the time factor. Knowledge of these matters is fairly definite, but details of the processes and actual reactions leading to the formation of petroleum from organic matter are still unknown.

The possible processes of conversion are those of radioactivity, bacterial action and catalysis. The evidence regarding each of these processes is summarized, and suggestions for future study in chemistry, physics, and biology are made.

E. N. T.

8. Grain Roundness—A Valuable Geologic Tool. G. Rittenhouse. *Bull. Amer. Ass. Petrol. Geol.* 1946, **30**, 1192.—The roundness of heavy minerals can be used as a valuable tool in geologic work, particularly in exploration for gas and oil.

Examples are given to illustrate how in the Appalachian Basin roundness has been used to differentiate producing zones and help interpret the geologic history of the area. E. N. T.

9. Geologists' Place in Service. P. H. Price. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1115.—Geologists were used in the late war, both in uniform and as civilians, to a far greater extent than in the 1914–18 war.

However, the potential value of the geologist in time of war as well as in peacetime has not yet been fully realized in official circles. E. N. T.

10. Expanding Activities of Paleontologists. J. R. Sandidge. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1088.—Economic paleontologists were originally employed as

microscopists for the routine examination of well samples. Today they are being given considerably wider scope and responsibilities.

Paleontologists are providing useful appraisals of stratigraphic history for exploration and exploitation work, and their work in these fields is likely to expand.

E. N. T.

11. Publication of Geophysical Case Histories. H. C. Cortes. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1095.—The need exists for publishing more geophysical case histories. It is suggested that a plan can be followed for this publication which will ensure that no information that a company wishes to withhold will be published, while at the same time providing useful data for workers and students in this field.

E. N. T.

12. The Geological Attack. M. G. Cheney. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1077.—This is the presidential address of the thirty-first annual meeting of the American Association of Petroleum Geologists, which was held in Chicago on April 2, 1946.

The author outlines the applications of geologic science, particularly with relation to the oil industry. E. N. T.

13. Pre-Selma Upper Cretaceous Stratigraphy of W. Alabama. W. H. Monroe, L. C. Conant, and D. H. Eargle. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 187.—The pre-Selma Upper Cretaceous beds of western Alabama have long been divided into the Tuscaloosa and Eutaw formations, but recent field work shows that six unconformable stratigraphic units can be mapped. These are, going down, the Eutaw, McShan, Gordo, Coker, Eoline, and Cottondale formations. Details of lithology are given.

E. N. T.

14. Mineralogy of Late Upper Cretaceous, Paleocene, and Eocene Sandstones of Los Banos District, West Border of San Joaquin Valley, California. S. N. Daviess. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 63.—The heavy mineral composition of 192 outcrop and core samples from Los Banos sandstones of late Upper Cretaceous, Paleocene, and Eocene age is tabulated. The conclusion is made that a study of the mineralogy of these sediments does not permit stratigraphic differentiation.

It is interesting to note that the minerals present seem to have been derived from both eastern and western sources. E. N. T.

15. Miocene Conglomerates of Puente and San Jose Hills, California. A. O. Woodford, T. G. Moran, J. S. Shelton. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 514.—The Puente and San Jose Hills form a triangular upland that rises above the Los Angeles, San Gabriel, and other physiographic basins east and southeast of the city of Los Angeles. Most of the conglomerates of the middle Miocene Topanga formation and the Upper Miocene Puente formation are in the form of thick lenses, with pebbles and boulders of plutonic, and metamorphic rocks.

It is probable that the basin which included the present area of these hills received debris from the north and east during Miocene times, and the transgressing shore line moved slowly inland, crossing the present northeast margin of the hills in early and middle Puente time. E. N. T.

16. Gramp's Field, Archuleta County, Colorado. W. A. Waldschmidt. *Bull. Amer. Petrol. Geol.*, 1946, **30**, 561.—The oilfield of this name was discovered in Colorado in 1935. Oil comes from the Upper Cretaceous Dakota sandstone, of which the producing thickness is 152 ft. The producing area is 127 acres, all privately owned. All wells are at an average height of more than 8000 ft. above sea level, and the average hole depth is 1250 ft.

Total production from Gramp's field up to January 1945 has been 2,124,202 brl. The structure is an east–west fault crossing a north–south anticlinal axis. E. N. T.

17. Correlation of Paleozoic Rocks Across Las Animas Arch in Baca, Las Animas, and Otrero Counties, Colorado. J. C. Maher. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1756.—The Hankins No. 1 well in S.E. Baca county, Colorado, penetrated Permian,

Pennsylvanian, Mississipian, and Ordovician rocks and was abandoned at 6171 ft in the Arbuckle limestone. This well was low on the southeast flank of the Las Animas arch, and wells drilled near the crest of the arch showed that more than three-quarters of this sequence is absent there, where Permian overlies thin Arbuckle strata, underlain by the pre-Cambrian.

On the west of the arch Mississipian formations overly the Ordovician. E. N. T.

18. Kinderhook Dolomite of Sedgwick County, Kansas. W. A. Ver Wiebe. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1747.—The Kinderhook dolomite of Sedgwick county, Texas, has given oil from several wells. It has been variously called Westerfield, Misener, Viola, and Hunton in the past, but the writer suggests that it is definitely Kinderhook in age. E. N. T.

19. Siluro-Devonian Strata in Central Kansas. Hall Taylor. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1221.—The Siluro-Devonian Hunton Limestone and overlying Misener sandstone occur in the subsurface over much of Central Kansas. They are only approximately equivalent to Oklahoma formations of the same name.

In some areas these beds are oil reservoir rocks. The lithology, correlations, and areal extent of the formations are described.

In north-central Kansas the Hunton is dolomitic. It thins southwestwards from several hundred feet to nothing. The Hunton of south-central Kansas is normally less than 60 ft thick, and is not directly connected with the northern beds. It is here probably Silurian in age. E. N. T.

20. Buried Pre-Cambrian Hills in N.E. Barton County, Central Kansas. R. F. Walters. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 660.—Six buried pre-Cambrian hills have been defined by drilling in the Kraft-Prusa, Beaver, and Bloomer oilfields. These are flat-topped quartzite modanocks on a Cambrian peneplain eroded across pre-Cambrian quartzite, schist, granite, syenite, granite-gneiss, and pegmatite. The hills are now buried under 3300 ft of Pensylvanian, Permian and Cretaceous rocks. Oil comes from Pennsylvanian limestones, shore-line sands of the Pennsylvanian, marine conglomerate, Cambro-Ordovician dolomite and residual sand, and pre-Cambrian quartzite.

The structural relationship of the buried hills to the overlying sediments is exhaustively analyzed. E. N. T.

21. Fossil Plants and Jurassic–Cretaceous Boundary in Montana and Alberta. R. W. Brown. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 238.—Fossil plants seem to indicate that there is an unconformity in the basal part of the Kootenai formation in Montana, and at the base of the Blairmore formation in Canada.

This unconformity probably marks the Jurassic–Cretaceous boundary. E. N. T.

22. Ellis, Amsden, and Big Snowy Group, Judith Basin, Montana. P. T. Walton. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1294.—The Judith Basin area of Central Montana is a topographic and structural low. Gently northeast dipping Upper Cretaceous Colorado shale beds occupy most of the Judith Basin, but outcrops of steeper, older formations are found in the surrounding mountains.

The Big Snowy group is divided into the Heath, Otter, Kibbey, and Charles formations, in descending order. It lies disconformably on the Madison in the southern part of the area.

The upper marine Amsden limestone overlaps successively the lower Amsden red-beds and the upper Big Snowy beds.

The Ellis is a transgressive marine deposit resting on a Jurassic marine evaporite series in the eastern part of the area, and overlapping the Amsden, the Big Snowy members, and the Madison at other localities. E. N. T.

23. Algæ Reefs in Cape Rock of Ogallala Formation on Llano Estacado Plateau, New Mexico, and Texas. W. A. Price, M. K. Elias, and J. C. Frye. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1742.—Reef bodies have been found in the Ogallala cap rock on the Llano Estacado plateau of New Mexico and Texas similar to those previously described from a limestone in the same position in Kansas and elsewhere on the Northern High Plains.

The characteristic concretionary structures of the reefs is described, and a syngenetic origin upheld for the banded concretionary bodies. E. N. T.

24. Stratigraphy of Upper Nehalem River Basin, N.W. Oregon. W. C. Warren and H. Norbisrath. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 213.—The rock sequence of the Upper Nehalem river basin is here divided into three distinct groups, separated by unconformities. The oldest group is the Tillamook Eocene volcanic series, which is followed by a belt of sediments ranging in age from Upper Eocene to Middle Miocene. The youngest group is that of the Columbia River basalts, which are of Middle Miocene age. E. N. T.

25. Lower Pennsylvanian Terminology in Central Texas. R. C. Spivey and T. G. Roberts. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 181.—The presence of fusiform fusulinids in Marble Falls limestone shows that this formation is post-Morrow in age. Lampasas is not appropriate as a series name, so elevation of the Atoka formation of Oklahoma to Atoka series, and use of this term in Central Texas is proposed. E. N. T.

26. Geology of Katy Field, Waller, Harris, and Fort Bend Counties, Texas. A. P. Allison and others. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 157.—The Katy field, 35 miles north of Houston, was discovered in 1935. The productive area is about 30,000 acres in extent, and contains the most important gas-condensate reserve in the United States.

The structure is a broad, unfaulted anticline. Gas-condensate and oil are produced between depths of 6250 and 7450 ft from Yegua sands.

On July 1, 1945, 85 wells had been completed in this field, of which 44 gave gas, 29 gave oil, and 12 were dry. At this date the average daily allowable production from this field was 1000 brl of oil, 14,000 brl of condensate, and 450 million cu. ft of gas, of which 85% is being returned to the reservoir. E. N. T.

27. Stratigraphy of Waller and Harris Counties, Texas. R. L. Beckelhymer. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 52.—In the Waller and Harris counties, Texas, a thickness of 11,004 ft of Gulf Coast Plain formations are known, ranging from the Lissie formation (Pleistocene) to the Wilcox (Eocene). The writer describes all possible methods of classifying and subdividing these sediments. E. N. T.

28. Lower Middle Ordovician of S.W. Virginia and N.E. Tennessee. C. E. Prouty. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1140.—The lower middle Ordovician of S.W. Virginia and N.E. Tennessee can be divided up into 29 lithologic and faunal units.

The two median belts directly autochthonous to the Saltville thrust show the most complete sections.

Detailed sections measured along seven belts are compared with the revised standard section of Tazewell County, Virginia, and the stratigraphy is examined in detail.

It is concluded that the current classification of major boundaries in Virginia and Tennessee should await further comparisons with the standard sections. E. N. T.

29. Late Paleozoic and Early Mesozoic Stratigraphy of Uinta Mountains, Utah. H. D. Thomas and M. L. Krueger. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1254.—At the western end of the Uinta Mountains the Jurassic formations are, going upwards: Nugget sandstone, Twin Creek limestone, Preuss redbeds, Stump sandstone, and Morrison formation.

Going eastward along the mountains, it is found that the Nugget sandstone persists, but is called the Navajo; the Twin Creek limestone intertongues with the Carmel redbeds; the Preuss redbeds grade into the cross-bedded Entrada sandstone; the Stump sandstone grades into Curtiss shales and limestones; the Morrison thins and becomes less conglomeratic. E. N. T.

30. Recent Investigations by United States Geological Survey of Petroleum Possibilities in Alaska. J. C. Reed. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1433.—As a war emergency measure the United States Geological Survey in 1944 and 1945 examined

the oil possibilities of several areas in Alaska. These were the Gulf of Alaska area, the Alaska Peninsula–Cook Inlet area, and northern Alaska.

In the Gulf of Alaska area the oil accumulations will be confined to Tertiary strata. In the Alaska Peninsula–Cook Inlet region Jurassic rocks overly a possible source in the Triassic limestone. In Northern Alaska exploration work is being carried on by the Navy Department in Naval Petroleum Reserve No. 4. Here there is a great area of gently folded Cretaceous rocks.

It is concluded that much additional information must be gathered before it is possible for geologists to estimate the potential oil reserves of Alaska. E. N. T.

31. Tectonic Framework of Northwest South America. F. E. Von Estorff. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30,** 581.—This paper is a discussion of the tectonics which have influenced the area between Latitude 12° North and 6° South, and Longitudes 66° and 82° West. It covers all of Colombia and Ecuador, and parts of Panama, Venezuela, Brazil, and Peru.

It is concluded that there are two major trends, orientated at approximately N. 40° E. and N. 30° W. These trends are continuous over large areas and intersect at about 70°. These trends probably reflect the orientation of large crustal blocks, and have a profound influence on the sediments and consequently the accumulation of oil. E. N. T.

32. San Pedro Oil Field, Province of Salta, N. Argentina. L. C. Reed. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30,** 591.—The San Pedro oilfield is the most important of the northern Argentina fields. There are seven fields in this area which have between them accounted for some 10% of the total oil production of Argentina. San Pedro had produced 12,941,259 brl of oil up to the end of 1944.

Geologically, it is situated in the Permo-Carboniferous Tarija basin, in which there is probably as much as 30,000 ft of sediments. The oil reservoirs are in the glacial sediments of the Permo-Carboniferous, the oil source rocks being probably Devonian. The structures are typically thrust-faulted anticlines.

The Tarija Basin fields are remarkable for the great age disparity between the formation of the source beds, in the Devonian, and the first folding, in the late Tertiary, which could have caused accumulation. E. N. T.

33. Micropalæontology of Upper Cretaceous and Paleocene in W. Ecuador. H. E. Thalmann. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30,** 337.—In the western, coastal area of Ecuador, the Upper Cretaceous is present as the Callo and Guayaquil formations, and the Paleocene is represented by the Estancia formation. This paper gives notes on the lithology and microfossil content of each of these formations, which are very poor in microfauna when compared with the equivalent strata in northern Peru and Colombia. E. N. T.

34. Geological Reconnaissance of S.E. Peru. V. Oppenheimer. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30,** 254.—This paper gives the results of a geological reconnaissance made across the Cordillera de Vilcanota and the Cordillera de Carabaya of south-eastern Peru.

The regional geology is largely represented by pre-Cambrian schists and quartzites, overlain by Ordovician slates. Upper Paleozoic shales and sandstones occur to the west of the section, and to the east there are vast Tertiary plains.

Structurally, this part of the Cordillera Oriental is normally block-faulted. E. N. T.

35. Geology of Maracaibo Basin, Venezuela. F. A. Sutton. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30,** 1621.—The Maracaibo Basin in northwest Venezuela occupies a structural and topographic depression between the Andes de Merida and the Sierra de Perija. The basin extends into eastern Colombia.

The area of the basin is 23,572 square miles, of which about 5000 square miles are covered by the brackish Lake Maracaibo. The maximum elevation in the basin is 328 ft, and large tracts are therefore swampy.

Oil was first discovered in 1914 in the Mene Grande field, and at present there

are thirteen active fields within the basin—eight in Venezuela and five in Colombia. In 1945 the production was 9% of the world total, *i.e.*, 221,730,000 brl. On December 31, 1945, the cumulative production was 2,634,430,000 brl. Present reserves are estimated as 5,500,000,000 brl.

The highlands bordering the lake show a geologic section extending from the pre-Cambrian to the Recent. Oil is found in all but two of the seventeen formations between the top of the Middle Cretaceous and the Middle Miocene. This sequence has an overall thickness of 23,000 ft.

Accumulations are both stratigraphic and structural.

The Bolivar Coastal field, one of the largest fields in the world, is on the lakeward-dipping northeastern limb of the basin, on a monoclinal structure. This field produced 186,861,000 brl during 1945. E. N. T.

36. Geological Occurrence of Oil in United Kingdom, with Reference to Present Exploratory Operations. H. R. Lovely. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1444.—The search for oil has been carried on in the United Kingdom since 1936 by several major companies. "Wild-catting" by independent operators has not been encouraged, and geological information of the subsurface is therefore still relatively limited.

This paper discusses in detail the geological history of the country from the petroleum geologist's point of view. Great Britain has lain for the most part outside the major geosynclines of sedimentation, and has been subjected to three violent orogenies.

These factors have limited the possible oil accumulations to local pools in the Carboniferous and Jurassic rocks.

There are widespread minor oil shows, but to date the only commercial accumulations have been found in the English equivalent of the Pottsville, Pennsylvanian system.

It is concluded that while future oilfields are likely to be found, these will be of a restricted nature. E. N. T.

37. Petroleum Geology of Aquitaine Basin, France. A. J. Eardly. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1517.—The French Government and some private interests are at present exploring the oil possibilities of the Aquitaine Basin in S.W. France. This is a large Mesozoic and Tertiary basin, about 200 miles across. Gas has been found in one district near the Pyrenees.

The possible oil beds are the Jurassic and Upper Cretaceous, which should be found not deeper than 3000 ft in the central part of the basin.

There is an interesting zone of gypsiferous shale plugs or domes in a foothill belt of the Pyrenees. E. N. T.

38. Oil Fields of Carpathian Region. R. P. Walters. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 319.—This paper reviews the known oilfields of Europe west of Russia. All these fields lie in the region of the Carpathian Mountains, which are a northern offshoot of the Alps, extending from the Little Carpathians east of Vienna, through Poland and Roumania, and bending eastwards into the Balkan Mountains.

The major oilfields of Poland, the eastern Roumanian fields and the rich southern fields of Roumania lie on the outer edge of this mountain arc. The Transylvanian gas fields and the small oilfields of S.W. Hungary lie inside the arc, and the Austrian fields are associated with the outside.

In the Vienna Basin oil comes from the Sarmatian (Upper Miocene), the Schlier (Mid-Lower Miocene), and from the Flysch. Structures are related to faulting along a buried Flysch ridge.

In Poland production comes from complex overthrust structures, from Oligocene reservoir horizons. In eastern Roumania there are mainly overthrust structures with Oligocene, Eocene and Lower Miocene reservoirs. The southern Roumanian fields, centred round Ploesti, produce 98% of that country's oil, mainly from Pliocene sands (Dacian and Meotian), with some Miocene and Oligocene production. Salt has played an important structural part in the Roumanian oilfields.

In Transylvania, much gas is obtained from Sarmatian beds in anticlinal folds. The southwest Hungarian fields give oil from normal anticlines from lower Pliocene strata. E. N. T.

39. Evolution of Reef Corals in East Indies since Miocene Time. J. H. E. Umbgrove. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 23.—It has been found that the percentage analysis of Upper Tertiary corals in the East Indies can be used as a method of stratigraphic correlation. The percentage of present living species increases from 0–50 in the Miocene to 50–70 in the Pliocene and 70–100 in the Pleistocene and Recent. It seems likely that the evolution of the reef corals evolved smoothly except for accelerations in the Upper Miocene and Pliocene, the reasons for which are discussed. A comparison is made between the evolution rates of reef corals and of molluscs.
E. N. T.

40. Oil Basins of East Indian Archipelago. H. M. Schuppli. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1.—This paper analyses the regional tectonics of the Tertiary oil basins of the East Indies. There is an accompanying geotectonic sketch map of the area.

The oilfields of Sumatra, Java, and Borneo had produced more than a billion barrels of oil up to the end of 1940. There are still very considerable proved reserves. Most of the oil was produced from Miocene and Pliocene sands, but shortly before the Japanese invasion commercial pools were discovered in the Eocene. Triassic oil is known in the Boela field of Ceram.

Structures are usually gentle to moderately steep anticlines, and stratigraphic traps which doubtless also occur have as yet not been exploited.

The geotectonics are complex, being the result of the folding of two major geosynclines into orogenes and their intersection. These are the circum-Asiatic and the Australo-Pacific geosynclines. The Tertiary basins of Borneo lie outside these two belts and are really intra-continental geosynclines. E. N. T.

Geophysics and Geochemical Prospecting.

41. Geophysical Patent. H. T. Kennedy, assr. to Gulf Research and Development Co., U.S.P. 2,406,611, 27.8.46. Geochemical Prospecting Method.—A method of prospecting for subterranean gas and oil deposits based on the quantitative determination of the ethane content of ground water samples taken from surveyed points in the region. R. B. S.

Drilling.

42. Developments in Oil Drilling Equipment. A. G. Arend. *Petroleum*, 1946, **9**, 240.—The search for reliability in drilling plant, especially necessary at great depths, has led to the development of improved rotary plant, and a general simplification in construction. Comparison is given with plant used in earlier practice.

Stepless regulation has now been replaced by 4, 6, or 8 rates of speed which has been found satisfactory even at extreme depths. Construction of modern motors is discussed and details of modern drilling technique given. K. C. G. K.

43. Development, Use, and Care of Drilling Equipment. F. F. Murray. *Oil Gas J.*, 5.10.46, **45** (22), 100.—A brief and general discussion of the need for co-operation between manufacturer and user of drilling equipment is presented. A. H. N.

44. Drilling Costs Up Sharply Above Prewar. D. I. Siskind. *Oil Wkly*, 7.10.46, **123** (6), 37.—The causes for higher drilling costs are analysed. These include higher wages and salaries, more expensive equipment, shortages, less efficiency among workers, greater drilling depths, more wildcatting, and relatively more dry holes drilled. A. H. N.

45. Hard-Rock Rotary Drilling. F. L. Scott. *Oil Gas J.*, 5.10.46, **45** (22), 74; *Oil Wkly*, 7.10.46, **123** (6), 17. (*Presented before San Antonio Meeting of American Association of Oil Well Drilling Contractors.*)—Comparative hardness of rocks is discussed and tabulated. Diagrams are presented from which the speed of drilling in different rocks may be estimated from the speed of rotation and weight on the bit. Increase in weight on hard rock may increase rate of penetration; in soft formation it may merely flounder the bit. Experience has to be gained before using general

rules. A sharp bit, when run with initially heavy weight on dolomite (a hard rock having high strength), will suffer undue tooth breakage. A programme including a minimum starting weight, with a gradual increase as the bit dulls, would not only maintain an average desirable penetration rate throughout the run, but should secure more footage/round trip. The stresses in teeth of roller bits are briefly indicated, and the metallurgy and engineering problems of bit design are outlined. The influence of the circulating fluid and drill stem on drilling are discussed. A. H. N.

46. Bollard Method for Shallow Water Drilling. A. J. Tucker. *Oil Wkly*, 16.9.46, **123** (3), 98.—The method is developed for depths from 8 to 21 ft. A landing ship (tanks) is converted for drilling by installing a derrick and requisite machinery on the forecastle head. In the hull, where the bow ramp aperture was located, an alteration has been accomplished so that drilling can be conducted through the bottom of the ship. On deck and abaft the rig, pipe racks have been installed on either side of the centre line to hold drill stem, casing, and spare pipe. Between these racks, the "lawdown" device travels. Vessel is moored to four buoys on bow and quarter and is sunk onto the ocean floor. The Bollard is sunk in position in the drilling chamber and is enclosed within the three walls and the bow doors, thereby serving as pivot point for the ship. Through the Bollard, drilling operations are conducted. Safety and other considerations are briefly discussed. A. H. N.

47. Shell's Rig Makes Successful Attack on West Texas Chert. E. H. Short, Jr. *Oil Gas J.*, 12.10.46, **45** (23), 76.—The drilling in West Texas is very hard and a special rig was made which cost approximately 7% more than the standard rig, but which effected about 23% saving in well cost. The derrick was raised by 7 ft 8-in and the drum speed was increased with automatic brake controls being introduced. In order to reduce circulating pressures in deep drilling, a special string of 5–9/16-in drill pipe was used. This string was made up of standard A.P.I. Grade E Range 3 drill pipe with a special requirement of 42–44 ft range length, with 4½ to 5¾-in o.d. by 3–5/32-in i.d., extra-hole tool joints, flash-welded on to the pipe. A groove was cut at the thickest part of the pin end of the tool joint to enable the driller to see the break point clearly when coming out of the hole. In view of the requirement for deep drilling that either slush pump should be available for mixing mud or standby, and that the engine powering the rotary table should preferably not be connected to any engines which are operating pumps, four 6-cyl engines were included in rig design to obtain the utmost flexibility. Incorporation of all main engines into one transmission permits the maximum use of available horsepower, and breakdown of one engine usually affects the performance of the rig only slightly. The engines operate on natural gas and deliver a peak total of about 1200 hp. at 800 r.p.m.

Other changes were effected in mud tanks and ditches and auxiliaries. The performance of the rig is described with the aid of charts and other records of the drilling operation. A. H. N.

48. California Drilling Practices. F. N. Kellogg. *Oil Gas J.*, 19.10.46, **45** (24), 140.—Practical details of the average practices in California, of sizes and capacities of drill pipe, bits and other equipment, of speeds and weight on bits, of mud characteristics and safety practices are reviewed. A. H. N.

49. Boring with Diamond Drill. Anon. *Petroleum*, 1946, **9**, 230.—Details are given of recent achievements in coring with diamond drill bits containing 400 to 500 diamonds totalling 60 to 100 carats in an aluminium bronze alloy bond. The tests were made in central Oklahoma, western Kansas, and southeastern Mexico at 7300 ft, 3700 ft, and 7000 ft total depths in limestone and dolomite formations. K. C. G. K.

50. Big Slush Pump. J. E. Kastrop. *Oil Wkly*, 9.9.46, **123** (2), 58.—This recently introduced duplex power-driven pump is capable of transmitting almost 600 hp. into the drilling fluid circulatory system. This makes it possible to handle high viscosity fluids at great depths with little concern for overburdening pumping equipment or sticking drill pipe. From the characteristic curve of the pump it is seen that 763 gal of mud/minute are delivered with a 7¼-in piston at 55 strokes/minute with per-

missible pressures up to 118 lb/sq. in. A maximum permissible pressure of 2910 lb/sq. in is developed by the 5-in diameter piston which delivers 295 gal/minute at the rated speed of 55 strokes/minute. These figures are based on 100% volumetric efficiency up to a maximum permissible pressure indicated for each size liner. Pump design considerations are discussed. A. H. N.

51. Reverse Circulation in Oklahoma Wells. C. L. Myers. *Oil Wkly*, 23.9.46, **123** (4), 29.—Reverse circulation is being used in completion of wells up to 10,000 ft in depth. Reverse circulation completions have been found especially effective in wells plagued with caving shale which is easily and quickly washed to the surface without clogging the pay and thus reducing porosity. Where the oil horizon is a sandy shale and has to be shot, or in bore holes with a low bottom-hole pressure, this method has been found successful. Rigs used in reverse circulation completions or cleanouts resemble larger rotary units, but are much smaller. The rigs contain certain features peculiarly adapted to the class of work they must perform. One company operating out of the Tulsa area has developed several unique devices, including a washing tool, an application of the torque converter for servicing, a four-way valve, and a specially constructed packoff head, all of which have been used effectively. In the Stroud pool approximately 38 wells serviced by this method and using these and other specially designed equipment reported exceptionally good results and increased production. Typical examples are reported. An important advantage claimed for reverse circulation is that of accurate logging while drilling in. Because of the velocity with which cuttings are brought to the surface, it is possible on a 4500-ft hole to cut one foot of formation and have the cuttings at the surface in seven minutes. Using normal circulation it would take cuttings from a comparable depth approximately 2½ hours to reach the surface. Other advantages claimed for the method include rapidity in putting wells on production, protection to the producing formation, no loss of oil or gas in the process, greater efficiency in shot holes, and greater economy. The method and equipment can be successfully applied to drilling in, deepening, cleaning out, plugging back, acidizing, fishing, pulling tubing and rods or running same, swabbing, sand pumping, bailing, drilling out retainers and cement, and conditioning hole for squeezing and perforating. Reverse circulation is compared with standard drilling under different circumstances. A. H. N.

52. Drilling Patents. V. Guillemin. U.S.P. 2,406,764, 3.9.46.—Automatic Graph Drawing Recorder: a graph drawing machine (which could be adapted to log drilling rig functions).

M. O. Johnston. U.S.P. 2,407,081, 3.9.46. Gun Perforator for Well Casing: a gun perforator in which the projectiles are held by a flange until the firing power of the explosive shears the flange from the projectile. R. B. S.

Production.

53. Trends and Developments in Petroleum Production Engineering. S. E. Buckley. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1131.—This paper summarizes the trends and developments in petroleum production engineering since 1941.

The most important trend in recent years has been the transition from the qualitative to the quantitative stage. This process is by no means complete yet, but the modern petroleum production engineer must think more and more in a quantitative fashion. E. N. T.

54. Bacteria in Oil Production. Anon. *World Pet.*, 1946, **17** (12), 78.—A brief description is given of the efforts being made by the Pennsylvania Grade Crude Oil Association to eradicate those water-borne bacteria which are undesirable (sulphate reducers, slime producers, etc.). The degree of toxicity of the additives being investigated is limited by the fact that the input water is used for drinking. A short review is given of the work of Dr Zobell, pertaining to the part bacteria play in the formation and transformation of petroleum hydrocarbons. F. S. A.

55. Mathematical Methods of Decline Curve Extrapolation and Reserve Calculation. S. J. Pirson. *Oil Wkly*, 9.9.46, **123** (2), 45.—There are several types of decline curves and these must be defined strictly for any particular problem. The different types

are defined and explained. In order to estimate the future production of a well, tract, field, or pool by means of production decline curves, it is necessary to project into the future the past performance of the producing unit. The accuracy and reliability of this projection depends to a large extent upon the accuracy of the production data as recorded in the past and on the judicious application of correction factors for disturbances caused by well repair jobs. The reliability of the reserve estimates will further depend on the proper use of methods of curve extrapolation. These methods may be grouped into two classes, as follows: (1) Mathematical methods. (2) Graphical methods. Essentially, the mathematical solution of a decline curve problem involves three problems: (*a*) The recognition of the type of formula or curve which best fits the data or measurements in the present case production rate (y) in barrels/unit of time (t) chosen (year, month, week, or day). (*b*) The calculation of the arbitrary constants which enter the formula which fits best. (*c*) The calculation of the expected future production or reserves to a given or assumed economic limit. The paper gives the mathematics of decline curves, which are: (1) linear, ($y = mt + a$); (2) exponental ($y = a \exp(-bt)$; (3) parabolic, ($y = at^{-b}$); (4) hyperbolic ($y = a + \frac{b}{t}$) or $y = \frac{1}{a + bt}$, and (5) complex parabolic curves requiring several constants. The method of successive differentials (Loss Ratio Method) is also given. Each formula is derived and an example is worked out in detail as illustration.

A. H. N.

56. The Permian Basin Fights Corrosion. G. Weber. *Oil Gas J.*, 14.9.46, **45** (9), 76.—In attempting to deepen wells producing from three sands it was found that corrosion above the gas–oil contact severely attacked the pipes in a New Mexico field. Following this discovery indicating serious corrosion in other wells in the field, the company adopted measures to remedy the damage already done and to prevent its continuing. All wells showing casing leaks are being lined with 5½-in casing. Then, following a practice adopted in the Mangolia field of South Arkansas, a production packer is set near the bottom of the tubing string, and the annulus between tubing and casing is filled with sweet, refined gas oil. The same programme, except for lining of the 7-in casing, is followed for wells not yet showing casing leaks. Whether caused by chemical or electrolytic action, corrosion will be halted by the static oil column. At first crude oil was used to fill the annulus, but since such oil is sour and contains as much as 1% of water it would require treating before being considered entirely safe for such use. The small additional cost of gas oil was considered worth the complete protection it affords. A total of 14 flowing wells at Hobbs have been reworked in this manner, and the company has scheduled 8 more for immediate attention. In addition, key wells throughout the field which are flowing at high gas–oil ratios and making water are being calipered, and if it is indicated that corrosion justifies remedial work, it will be undertaken. On the basis of what was learned at Hobbs, the company is investigating wells in other fields. Corrosion of tanks in the same fields is also discussed. Aluminized steel tanks have been found resistant to sour crudes for 2 years.

A. H. N.

57. Sodium Chromate as a Corrosion Inhibitor In Gas-condensate Wells. Part 1. C. K. Eilerts, H. A. Carlson, R. V. Smith, F. G. Archer, and V. L. Barr. *Oil Wkly*, 30.9.46, **123** (5), 17; 7.10.46, **123** (6), 30.—See Abstract No. 875, 1946.

58. Scales in Oil-producing Equipment. L. C. Case. *Oil Gas J.*, 28.9.46, **45** (21), 76.—It is stated that scale formation constitutes a secondary source of equipment troubles and treating costs when compared with, say, oilfield corrosion. Various types of scales occur in different parts of field equipment which handle water. Formation of these scales is due to a variety of causes, which may be present in water ranging from fresh to quite salty in nature. In general, scale formation should be considered as a chemical precipitate resulting from two main causes: (1) supersaturation, (2) the mingling of two different waters having incompatible compounds in solution. There is usually nothing difficult about the identification of a scale deposit. A few simple tests will serve to establish the major constituents. It should be understood that some of the solid substances found in scales may result from either one of the

two main causes, or they may be due to a combination of these physical and chemical conditions. Certain scale components can be due only to one definite mode of origin. Thus, identification of the main constituents in a scale may point immediately to its origin and a practical method of prevention. Scales are classified, in tabular form, and characteristics of the chief types are briefly described. The chemistry of scale precipitation is given, followed by typical scale surveys in different localities—in some examples several tons of scales may be removed from tanks on a lease, or 6-in pipes may be found completely blocked. Prevention and removal of scale are not discussed here; they are deferred to a following article. A. H. N.

59. Prevention and Removal Methods for Scales in Oil-producing Equipment. L. C. Case. *Oil Gas J.*, 5.10.46, **45** (22), 68.—Hard scale deposits, consisting essentially of the sulphates of barium, strontium, or calcium, are both difficult and expensive to remove from oilfield equipment. It should be clearly understood from the acid tests which serve to identify this type of deposit that it cannot be removed satisfactorily by acid treatment. Ordinarily, the sulphate scales are sufficiently hard to prevent displacement by either scrapers or boring tools. The last resort of hanging tubing or pipe in the derrick and dislodging the scale with hammers is very unsatisfactory, especially when damage to the pipe is taken into consideration. Prevention of scale formation is the best remedy. Prevention is accomplished in the most positive manner by not allowing mixtures to take place which cause the precipitation. If this method is definitely impracticable, continuous treatment with organic protective colloids, plus lesser amounts of certain polyphosphates, offers considerable promise of future development in reducing the rate of hard scale accumulation. Once allowed to accumulate, the removal of hard scales presents various difficulties which may be overcome only to some extent by full use of the latest developments. Soft scales, consisting mainly of carbonates of calcium, are easier to remove chemically and mechanically than the hard sulphate scales. HCl is used successfully in various strengths. The use of polyphosphates alone or with caustic quebracho tannin has also been reported. However, even for soft scale, prevention is recommended as better than removal. Several typical examples are discussed. A. H. N.

60. Sucker Rod Scrapers Eliminate Paraffin. C. E. Blackburn. *Oil Wkly*, 30.9.46, **123** (5), 29.—Over 385 wells are reported to have been equipped with this novel device. In pumping wells having paraffin accumulation, the depth at which the paraffin commences to accumulate is determined and rods equipped with scrapers to cover this distance plus an additional 200 ft are installed. The rods, with the attached scrapers, are rotated a fraction of a revolution on each reciprocation of the rods by means of a rotating hanger. As the blades reach within a fraction of an inch of the tubing wall, the reciprocation and rotation of the blades prevent any paraffin from accumulating. This provides a mechanical method which requires no attention after installation, as the action of preventing paraffin accumulation is automatic and continues as long as the well is pumped. For 2-in tubing the scrapers are $\frac{1}{4}$ in thick by $1\frac{1}{2}$ in wide $\times$ 2 ft long and are shrunk-welded to a prefitted ring around the rod. The scraper blades are spaced 2 ft apart and six such blades are placed on each rod. As the rod string is rotated and reciprocated, the full tubing area is wiped of paraffin. For tubing larger than 2 in, proportionally wider blades are used. The rotating head is rotated automatically by a bridle line from the jack head. A. H. N.

61. Mid-Continent Water-Flood Trends. W. A. Heath. *Oil Wkly*, 23.9.46, **123** (4), 33.—Methods of evaluating oil-in-place in the sands are briefly indicated. Well spacing in the 5-spot pattern is the most popular. The use of old wells for water injections are discussed followed by a study of unitization projects, experimental floods, selective shooting and plugging, and general production characteristics. A. H. N.

62. Capped 65,000,000 cu. ft. Well Loose at Surface Hole. Anon. *Oil Gas J.*, 28.9.46, 45 (21), 87.—In an expensive California oilfield well exceedingly high pressure developed in the annulus between the $11\frac{3}{4}$-in surface pipe and the 7-in oil string, culminating in failure of the surface connections. Failure started with a leak in the weld

securing the base unit to the surface casing and in a short time the flow of gas, sand, mud, and water cut out the side of the base unit and then cut out the christmas tree and suspension parts supporting the 7-in casing at the ground level. Remaining portion of the christmas tree was removed from the well by the operating crew, and all surface fittings were stripped down to the base plate. Decision was reached to use a packer constructed in the form of an inverted liner hanger, of such size that it could be passed down around the 7-in oil string and inside the 11¾-in surface pipe. Thus, it was hoped the 11¾-in casing could be sealed in and the pressure equalized in the annulus. It was also decided to screw a nipple on top of the inverted hangar and use a gate valve to close the well. The technique adopted in stabbing the well—and the solution of certain unexpected troubles which developed during the operations—are described and illustrated diagramatically. A. H. N.

63. Shell Runs New Well-Screening Device. W. S. Crake. *Oil Gas J.*, 5.10.46, **45** (22), 65–66.—A typical sand analysis is presented for a particular field from which it is seen that a screen with openings of only 0·008-in has to be used if sand is to be excluded. With such fine-mesh screens, it is impossible to set the screen in mud and then clean it; the mud sticks to parts of the screen, causing excessive flow in other parts, which ruins the screen. The device described in the paper consists of a fully enclosed, wire-wrapped screen which is run into the well in an oil- or grease-filled case to avoid damage to, or mudding up and clogging of, the screen while going in the hole. The device, which is suspended on a washing-type shoe, carried a delayed-action liner hanger and packer on the top portion of the enclosing case. The well is washed with water to bottom with the entire assembly, to be sure the well is clean to the final shoe-setting point. This washing operation is carried on until the well is free of liquid mud at bottom and, if desired, until the well shows signs of life, at which time at least part of the mud filter cake is probably dislodged. The entire assembly is then raised to the hanging point, the liner hanger is engaged against the casing, and enough weight is applied to the assembly to shear the upper pin which holds the device in a telescoped position. The screen is then lowered out of its oil-bath case in a perfectly clean condition into a well free of mud until it is fully extended, where it is latched into a locked position. Continuous washing is maintained during this time.

When the well is considered sufficiently well washed in, additional weight on the tool shears the pins on the liner-hanger slip bowl and the packer is collapsed, thus sealing off the device. The tubing is then disconnected from the shoe by simple right-hand rotation and picked up to the desired hanging position, and the well is then placed on production. The device can be recovered by releasing the packer and using the outer case as a washover tool to enclose and remove the screen.
A. H. N.

64. Co-operative Salt Water Disposal System Serves Erath Operators. Anon. *Oil Wkly*, 7.10.46, **123** (6), 28–29.—A co-operative salt water plant has been recently installed in Louisiana and it has been designed with neatness, compactness, efficient oil separation, and facilities for handling overflow emergencies as main features. The plant is described. A. H. N.

65. Ark-La-Tex. Has Good Gas—Conservation Record. G. Weber. *Oil Gas J.*, 2.11.46, **45** (26), 82.—An account is given of the conservation of waste gas in the Arkansas area. The gas waste situation in South Arkansas was complicated by the presence of hydrogen sulphide in 98% of wet gas to the extent of between 30 to 4450 g/cu. ft. The state forbids the use of gas for carbon-black manufacture. During the six years ending December 1945 the wet-gas production more than doubled, but waste in the fields was reduced from 19 billion to about 5¼ billion cu. ft annually. Three treating plants with a network of gathering lines process the sour gas for liquid fractions and treats the residue for refinery, industrial, and domestic conservation. Low pressure gas formerly flared is now processed and delivered to the field for gas lift and to pipelines, saving 1,000,000,000 cu. ft of gas. G. A. C.

66. Production Patents. W. H. J. Brock, assr. of one-half to Automotive Products Company, Ltd. U.S.P. 2,406,488, 27.8.46. Coupling Device for Pipes or Tubes:

a tube coupling device in which a collar is forced to contract into biting engagement with the pipe to form a fluid tight seal.

L. C. Hudson. U.S.P. 2,407,010, 3.9.46. System for Producing Regulated Liquid Pressure: a system for regulating an adjustable flow control valve.

H. Schiller and A. Shapiro, assrs. to Socony Vacuum Oil Co. Inc. U.S.P. 2,407,180, 3.9.46. Method of Purifying Oil Field Waters: a method of removing traces of petroleum from oil field waters by passing through a clay bed containing granules of ferrous sulphide, which absorbs the petroleum.

L. G. Daniels. U.S.P. 2,407,538, 10.9.46. Automatic Water Treating Device: an automatic water treating system combining a treatment tank and a reagent tank with a special conduit system for automatically adjusting the flow of raw water, treated water, regeneration reagent, and waste. R. B. S.

Oilfield Development.

67. Statistics of Exploratory Drilling in 1945. F. H. Lahee. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 813.—During 1945, 5613 exploratory holes were drilled in the United States. Of these, 3036 were new-field wildcats, 1364 were new-pool tests, and 1213 were outposts. Among the new-field wildcats 351 were successful; among the new-pool tests 383 were successful; among the outpost tests 480 were successful.

The total exploratory footage drilled was 23,030,266 ft, or 4103 ft per hole.

Although all these figures show an increase over 1944, the *degree* of success, measured in barrels of oil discovered, shows a decline. E. N. T.

68. Developments in Eastern Interior Basin in 1945. A H. Bell. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 879.—Drilling in the Eastern Interior Basin decreased 15% and production decreased 2¼% in 1945. Total production in 1945 amounted to 88 million brl, which was 5·1% of the United States total. E. N. T.

69. Developments in South Arkansas and North Louisiana in 1945. W. S. Hoffmeister and Van D. Robinson. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1007.—A total of 692 wells were drilled in this area in 1945, compared with 547 in the preceding year.

South Arkansas claimes 3 new oilfields and three new producing zones in old fields. North Louisiana had 7 new oilfields, 4 new gas fields and several new oil and gas horizons.

The total South Arkansas production for 1945 was 28,547,400 brl, while that of North Louisiana was 25,722,270 brl. The total for the whole area showed a decrease of 2·9% since 1944. E. N. T.

70. Developments in Arizona, Western New Mexico, and Northern New Mexico in 1945. R. L. Bates. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 958.—3 dry holes were drilled in the southern half of Arizona and 16 unsuccessful wildcats in northern New Mexico.

Three successful wells were drilled in the San Juan area. The Barker dome of northern San Juan County gave a large volume of Pennsylvanian gas. E. N. T.

71. Developments in California in 1945. G. B. Moody. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 829.—410 exploratory wells were completed in California in 1945, with a total footage of 1,772,920 ft. This is an increase of 95 wells over the 1944 figures.

269 wildcat wells were drilled, with 9·7% success; 50 new pool tests were drilled, with 40% success; 91 outposts were drilled, with 44% success.

38 oilfields and 8 gas pools were discovered. Although the new fields added about 220,000,000 brl to the reserves, none of them could be classified as a major discovery.

Production in 1945 was 326,444,000 brl of oil and 552,932,000 million cu. ft of gas. E. N. T.

72. Developments in Louisiana Gulf Coast in 1945. F. W. Bates and J. B. Wharton. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 999.—There were 12 new fields brought in

in this area during 1945, only one less than in the previous year. There were also 29 extensions of known fields and 38 new sands discovered.

New discoveries were all made at great depths, most below 10,000 ft, while one well discovered oil at 13,520 ft, which is the deepest production in the world.

During 1945, 615 wells were drilled and 107,379,429 brl of oil were produced.

E. N. T.

73. Developments in Michigan in 1945. H. J. Hardenberg. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 886.—In 1945, 801 wells were drilled in Michigan, and 2,005,044 ft were drilled. Of the completions, 334 are oil or gas wells, a success of 41% compared with 44% in the previous year.

Oil production was 17,267,493 brl compared with 18,489,470 brl in 1944. 14 oil-fields and 8 gas fields were discovered. E. N. T.

74. Developments in North Midcontinent in 1945. V. B. Cole and E. A. Koester. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 895.—Kansas produced 98,429,869 brl of oil and 124,100,219,000 cu. ft of gas in 1945.

Most significant discoveries were in the western part of the state, from Mississipian limestone.

The most extensively developed pool discovered during the year was the Ryan pool in Rush and Pawnee Counties.

Gamma-neutron and electrical logs were used in this area to an increasing degree.

E. N. T.

75. Developments in Appalachian Area in 1945. Appalachian Geological Society. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 861.—In the Oriskany development in New York State, 20 wells were completed and 16 were drilling. There were no new discoveries. In the Tuscarora Township field about 700 acres were proved productive. In the oil area of southwestern New York State completions were 1350, and daily average production was 12,402 brl per well.

In Pennsylvania, there was a decline of 19% in the wells completed in western Pennsylvania, compared with 1944. The only large new gas pool found was that in the Haskell sand, near Bradford, in McKean County.

Oil production from the Bradford field showed a further 11% decline, but still accounted for 50% of the Pennsylvania-grade oil produced in the Appalachian province.

In Ohio, 1034 wells were completed, of which 220 were oil wells, 429 were gas wells, and the remaining 385 were dry.

There was little activity in the Trenton fields of northwestern Ohio.

The only important new field opened during the year was in Columbiana and Mahoning counties, where oil was found in the Oriskany sand in a stratigraphic trap at a depth of 3600 ft.

Fewer wells were drilled in West Virginia than in the previous year. There were no new discoveries.

In Kentucky the most important oil developments were extensions to the pools in Elliot, Menifee, and Jackson Counties. Proven areas produced 1,524,764 brl of oil.

In Tennessee there were only 5 completions during the year. Oil production east of the Cincinnati Arch was about 6000 brl. E. N. T.

76. Developments in Oklahoma in 1945. J. L. Borden. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 6902.—Production of crude oil in Oklahoma totalled 139,227,502 brl in 1945, an increase of 12% on 1944. Reserves, however, declined by 8·3% to 889,839,000 brl.

2351 wells were drilled during 1945. The number of successful exploratory wells was 118. 51 new oilfields and 22 new gas fields were discovered, but there were no very outstanding discoveries in this area. E. N. T.

77. Developments in Rocky Mountain Region in 1945. E. W. Krampert. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 912.—Most discoveries in this area were in Wyoming, but even these were few in number.

The total footage drilled in the Rocky Mountain region was a little more than 1944, but the number of wells was less. Oil production increased by 5,000,000 brl due to

the development of the Rangely field. By the end of the year, Colorado's daily production was almost equal to that of Montana. E. N. T.

78. Production Report—Salt Creek Pool. H. S. Norman. *Oil Gas J.*, 19.10.46, **45** (24), 136.—This field, discovered through intensive re-examination of available geologic data, is small but relatively "rich". Covering only 100-odd acres, flowing production of 1700 brl/day (restricted) has easily been built up. Depth: 2800 ft; indicated recovery: 320,000 brl/well. Details of the pool are discussed. A. H. N.

79. Developments in Southeastern States in 1945. C. W. Alexander. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1020.—Alabama had 21 wildcats drilled, of which only 1 produced gas. The Gilbertown field had 14 new wells drilled into it and gave 186,817 brl of oil during the year.

Florida had 14 wildcats abandoned. One producer was added in the Sunniland field.

5 dry wildcats were drilled in Georgia.

In Mississipi, 117 wildcats were drilled which discovered 5 new fields and 3 salt domes. Mississipi fields gave 19,005,971 brl of oil in the year, as compared with 16,429,346 brl in 1944. E. N. T.

80. History of Reserves and Production of Natural Gas and Natural Gas Liquids in Texas. Perry Olcott. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1123.—The categories of natural gas and natural gas liquids are as follows: non-associated gas (free), associated gas (gas cap), and dissolved gas. The reserves of these three classes in Texas on January 1 1946 were a total of about 75 trillion cu. ft, divided respectively as 69%, 22%, and 9%.

Natural gas liquids are liquids obtained from any of the groups of natural gas by current field or plant practice. The total natural gas liquids reserves in Texas are estimated as 1·5 billion brl.

The gauged gas production in Texas during 1945 was 2·9 trillion cu. ft, and the natural gas liquids amounted to 61·5 million brl. E. N. T.

81. Developments in North and West-Central Texas in 1945. North Texas Geological Society. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 963.—Total oil production of this area in 1945 was 54,283,064 brl, a small increase over 1944. Wichita County was the leading producer.

2240 tests were drilled in 1945, resulting in 1227 productive wells and 1013 failures.

The most important areas of development were in the Sivell's Bend area in northern Cooke County, in central Montague County, and in the Harrold area, Wilbarger County. E. N. T.

82. Developments in the Texas Panhandle in 1945. P. A. Montgomery and Le Roy Fugitt. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 925.—There was a decided increase in drilling operations during the year. 516 new wells were completed during the year, of which 317 were gas wells, 159 were oil wells, and 40 were dry.

No new fields or producing formations were discovered.

In 1945 the Texas Panhandle produced more than 31,000,000 brl of oil from 6034 wells. This is a decline of 3,000,000 brl from the 1944 figures. E. N. T.

83. Developments in East Texas during 1945. T. H. Shelby, Jnr., and G. J. Loetterle. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 980.—The total of wells drilled in East Texas increased by 75 over the 1944 figure to a total of 392.

One new oil-producing area and four new gas-producing areas were discovered in 1945. All these fields produced from the lower Glen Rose or Travis Peak formations. E. N. T.

84. Developments in South Texas in 1945. B. Scrafford. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 972.—A record total of 1618 wells were drilled in this area during the year. Some of these were dually and triply completed.

479 wildcats resulted in the discovery of 47 new fields and the extension of 37 producing areas.

Total production of oil was 132,923,000 brl, *i.e.*, 7·7% of the United States total.

The Frio-Vicksburg trend accounted for 47% of the new fields discovered and the majority of the production. E. N. T.

85. Developments in Upper Gulf Coast of Texas in 1945. D. M. Davis and C. F. Beilharz. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 991.—Wildcat drilling increased by 24% and field drilling by 25% during the year. New discoveries were 26, mostly small in size.

Production decreased by 2½% during the year. Most of the wildcats were drilled on seismic prospects. E. N. T.

86. Developments in West Texas and Southeastern New Mexico in 1945. E. H. Woods, C. L. Chase and J. E. Bucher. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 930.—In West Texas 1744 wells were completed in 1945. Of the 278 exploratory wells, 47 were successful producers of oil and gas. 10 new Permian pools and 20 new pre-Permian pools were discovered. Pipeline runs were 175,540,000 brl in 1945, as compared with a total 14,760,000 brl lower in 1944.

In New Mexico, 393 wells were completed, including 67 exploratory wells, of which 19 were new producers. 9 new Permian fields were found, of which Paddock was the most important, and 1 pre-Permian field (Brunson).

New Mexico production for 1945 was 36,870,000 brl, a decrease of more than 2,000,000 brl on the 1944 total. E. N. T.

87. Development in Canada in 1945. G. S. Hume. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 851.—There was a decline in Canadian production from 10,166,208 brl in 1944 to 8,568,815 brl in 1945. This was due to the lack of new discoveries to offset the normal decline of Turner Valley, and the closing of the Canol pipeline which isolated the Norman Wells field.

Most of the 1945 drilling was done in Alberta. No new fields were discovered here. In the southern plains of Alberta the Conrad and West Taber fields have been extended.

The first commercial field in Saskatchewan, at Lloydminster near the Alberta boundary, began production in 1945. Previous production had been solely from the Alberta side of the boundary.

Test drilling has been carried out without notable success in various localities of Eastern Canada and also in the Mackenzie River area. E. N. T.

88. Exploration and Production of Petroleum. III. Anon. *Ind. Min.* (*Argentina*), 1946, **6** (60), 27–32.—Drilling methods are compared from the standpoint of efficiency and cost, and the various ways of lifting oil to the surface are described. (Cf. Abstract No. 1049/46.) A. C.

89. Status of German Oil Fields. F. Reeves. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1546.—This paper is a detailed and exhaustive review of the German oilfields, including much information about the fields discovered in the last few years.

28 new fields were discovered in the ten years prior to 1945, giving 62% of Germany's cumulative production. The annual production was doubled between 1935 and 1940, and in the latter year the peak production of 7,393,309 brl was obtained. This has since declined to 3,838,709 brl in 1945.

Most German oil comes from the Lower Cretaceous and Jurassic rocks on the flanks of salt domes. Only one important field, Reitbrook, has given oil from the crest of a deep-seated dome.

No new commercial oil has been found in the Middle Zechstein dolomites of central Germany since the original Volkenroda discovery in 1930.

New oilfields were found near the Dutch border in 1942 and 1943. They are situated on low folds, and produce from Lower Cretaceous sands and shell beds.

At Heide in Schleswig-Holstein, oil is found in Middle Zechstein dolomitic limestones and a pre-Neocomian scree breccia on the west flank of an elongate salt structure.

The Munich basin is the only untested area at present that might justify exploration work. E. N. T.

90. Post-War Development Progressing in Holland's Coevorden Field. Anon. *World Pet.*, 1946, **17** (12), 66–68.—Although the presence of oil was established in Holland in 1923, no serious search was made until 1933, when B.P.M. acquired certain rights. After the occupation the Germans resumed the work which the Dutch had had to abandon at the outbreak of war, and established several producing wells before 1945. Work has been resumed, but progress is slow on account of the use of out-of-date equipment and the waxy nature of the 25° A.P.I. gravity crude. Production statistics, geological information, and maps are reproduced. F. S. A.

91. Dutch Shell Group Restoring East Indies Properties Demolished on Eve of Invasion. Anon. *Oil Gas J.*, 12.10.46, **45** (23), 62.—The present status and future plans for the rehabilitation of the East Indies properties of the Royal Dutch Shell group of companies is summarized.

In Northwest Borneo the 20,000 brl Sarawak refinery and the Miri and Seria oilfields were demolished, and after recapture in July, 1945, drilling was resumed in 1946. 400 wells and tankage were destroyed on Tarakan, the 46,000 brl refinery at Balik Papan and oilfields on the east coast of Borneo also being demolished. Similar damage was done before the Japanese invasion at Ceram, New Guinea, Sumatra, and Java. The extent to which the invaders were able to reconstruct gave them an estimated yield of about 55% of the 1941 production, although they had arrived fully equipped to carry out repair work, Pladjoe and Java providing the greatest returns.

For reconstruction now, it is estimated that some 200,000 tons of equipment are necessary, including 27 strings of drilling tools, 600 pumping units, 40,000 kWh power generating capacity, and 200 miles of oil-well tubular goods, together with material to restore to the full the 20 million barrels of tankage.

Also an unknown portion of 3,000 miles of 4-in and larger pipelines must be replaced. G. A. C.

Transport and Storage.

92. Growth of the Pipeline Industry. Anon. *Oil Gas J.*, 21.9.46, **45** (20), 173.—The total crude oil and total gathering lines in the United States are shown from 1880 to 1915, for every five years, and yearly from 1916 to 1944. Petroleum pipeline traffic, trunk lines in thousands of miles, is shown from the year 1936 to 1944 for crude oil and refined products. The grand totals in each case are given, and the source of the data is shown. W. H. C.

93. Precise Engineering Features New California Crude Line. H. S. Norman. *Oil Gas J.*, 21.9.46, **45** (20), 230.—A description is given of the construction, laying, testing, and operation of the Standard Oil Co., of California's new pipeline between Kettleman Hills and the Los Medanos tanks at San Francisco Bay. The line is composed of 167 miles of 18-in and 9 miles of 20-in pipe and has a volume of 283,000 brl of crude oil, and a daily pumping capacity of 110,000 brl. There are 2 pumping stations. The line is provided with 6 boxes for inserting scrapers, and 13 gate valves to minimize loss and possible damage of territory in the event of a rupture. The pipes were electrically welded together and have yield strengths of 52,000 and 45,000 p.s.i., and ultimate tensile strengths of 72,000 and 65,000 p.s.i. respectively, on the first 30 miles of the discharge ends of each pumping station and the remainder of the lines. 27 miles of the line were made by the pressure-weld process. Gamma-ray testing was made on the welds. Water pressure tests on the various sections were made at 1000 and 1300 p.s.i. Part of the line was Somastic coated, where the most corrosive soil would be encountered, the remainder was wrapped with asphalt and asbestos felt. At Kettleman Hill intake station centrifugal pumps driven by steam turbines provided 940 p.s.i. pumping pressure; at Los Banos station the centrifugal pumps were operated by 800-hp. electric motors. The cost was $4,000,000. W. H. C.

94. 1946 Trends in Pipeline Practices. W. G. Heltzel. *Oil Gas J.*, 21.9.46, **45** (20), 182.—This paper discusses the future growth of product distribution pipelines,

possibilities of lines for transmitting coal gas, and problems of pipelines serving new oilfields. Up to about 1928, lines were constructed with threaded screwed pipes and couplings, and on this account a definite wall thickness was necessary so that standard weight pipes were used in which the wall thickness of the unthreaded portion provided greater strength than the operating pressures employed required. Lap-welded lines also required a substantial wall thickness to allow for the part expanded. The introduction of welding of circumferential joints and the adoption of electrically welded higher-carbon steels allowed greater scope for the designer, with the result that today thinner wall pipes and larger diameter lines are employed. Larger diameter systems are discussed; by substituting them for the present smaller lines, about half the number of pumping stations will be eliminated. Their advantages are: (1) low investment and low operating costs per brl of capacity; (2) means of obtaining greater pumping distances and as a corollary fewer pumping stations; (3) simplicity of operations; (4) adaptability for transporting crude oils having a wide range of viscosities; (5) suitability for batching; and (6) a medium through which a modernization programme of present trunkline systems can be carried out. The main disadvantages are: (1) large capital expenditures for first cost; (2) all of most of the capacity being in one line; (3) the problems encountered in the use of large valves and fittings; and (4) more difficult to construct. A tabulation shows the important data for pipelines from 6 to 24 in diameter, based on 960 p.s.i. working pressure, 24,000 p.s.i. working stress, 12 p.s.i. friction loss per mile, and 80 mile pumping distance, using tapering weights (except for the 6 to 10 in) that are suitable for the hydraulic gradient and practical for construction. Contamination of oils through batching is discussed in relation to various systems of pipelines. W. H. C.

95. Trends in Pipeline Practices. W. G. Heltzel. *Oil Gas J.*, 28.9.46, **45** (21), 81.—The shortage of high-grade iron ore in the United States necessitates the efficient use of steel for its conservation; this is supported by the economic limitations under which pipelines operate, which are conducive to the use of high-tensile steel, greater working pressure and thinner pipe walls. It is considered good practice to use a working stress equivalent to one-half of the rupture yield. The practical considerations when planning pipeline construction of less wall thickness are discussed with respect to internal and external corrosion, strength for bending, etc. According to the author, the practical limitations with respect to wall thickness for the various diameter pipes are as follows: 7/32-in wall can be used for 8 and 10 in and probably less wall for 6 in. Possibly 7/32-in can be used for 12 in. For 12 and 16 in. ¼-in wall has been used satisfactorily in seamless and electrically welded higher-tensile-strength pipe. It may prove satisfactory for 18 in. For 20 in and 22 in a minimum wall of not less than 5/16-in is recommended; experience may show that this minimum wall thickness can be reduced still further. He cannot offer an opinion on 24- and 26-in pipes.

The trend toward the use of less wall thickness is reflected in the quantities of the various sizes of pipe, having reduced walls, that have been used in some lines in recent years is shown by data giving length, size, and wall thicknesses. The use of tapering weights, *i.e.*, various weights of pipes in a section of a line tapering in wall thickness from the higher to the lower pressure end, primarily applied for one direction flow, is discussed and some examples of such construction are given, and the practical and economic advantages are discussed. These permit fewer pumping stations and longer pumping distances, etc. Pumping equipment, diesel engines employed, and the use of turbochargers and possible employment of gas turbines are surveyed.

W. H. C.

96. Pipeline Dimensions. W. L. Nelson. *Oil Gas J.*, 2.11.46, **45** (26), 91.—This issue No. 117 of the Refiners Notebook Series concerns the most economical tube length for some common still arrangements. An arrangement should be sought which utilizes few bends and tubes, but extremely long tubes are expensive. The distance between the top of the bridge wall and the roof tubes should never be less than 36 ins and preferably should exceed 4 ft if the still is narrow. A figure is given showing economical tube length as a function of heat duty of the still; types of still shown include three varieties of down convection, two of straight-up, and one of overhead convection. Notebook 104 should also be consulted. G. A. C.

97. Big-Inch Flow Chart. Affords simplified and quick method of determining line pressures to be maintained. H. W. Lambert. *Oil Gas J.*, 21.9.46, **45** (20), 222–4.—A Big-Inch Flow Chart is presented and its construction and method of use are discussed. The chart is for pipes from 13 in to 23·5 in internal diameter, and is a four-part logarithmic graph with the lines plotted for turbulent flow of viscous liquids in pipe lines. It accounts for losses due to pipe rougher than new clean steel pipe. The relationships used as the basis are well-known formulas, being arranged in such a manner as to solve quickly any ordinary flow problem. The chart was developed on account of the lack of meters at some of the line junction points, which made it necessary to rely upon pressure gauges to divide the streams in pumping determined quotas to their destination, and its construction afforded a simple and quick method of determining the line pressures to be maintained. The chart has been checked many times against various size lines and grades of crude oil and products. It has been found most useful when running scrapers through product lines. A flow chart is also given for 1¼-in to 12-in lines, which has been constructed by P. Buthod. Its method of use is described. W. H. C.

98. Protection of Two 8-in Coated Pipelines With Magnesium. A. Smith. *Oil Gas J.*, 21.9.46, **45** (20), 195.—A description is given of the Cathodic protection given by magnesium anodes to 4·4 miles of twin brine pipelines of the Dow Chemical Co., at Freeport, Texas. A resistance survey of the ground in which the line would be laid, from which the number of anodes required for protection, is described. Types of magnesium anodes are discussed as to size, weights, current developed, and life when under definite conditions of efficiency and output. The electrolyte or "backfill" in which the anodes are buried is described, and the protection of bare and wrapped pipe is discussed. W. H. C.

99. Standardized Electrification Pattern for Pipeline Pumping Stations. R. B. Mills. *Oil Gas J.*, 21.9.46, **45** (20), 217.—A recent electric installation is described. It was designed to modernize and extend a large oil company's pipeline system aiming at uniformity and standardization with compactness, reliability, and attractive appearance. At the sub-stations the main pumps are housed in a separate building to facilitate servicing, the operators control station being a pressurized room in the building. The transformers and switchgear are situated in the open, adjacent, but far enough away from the pump house for the latter to be in a safe area. All other electrical equipment is housed in separate compartments. The following types of equipment were installed: 750–2000 kva oil-cooled transformers, and switchgear with main and feeder breakers of the magneblast type; a 15 kva 2400–115/220-volt transformer for station lighting; a 2400–480-volt Pyranol transformer of either 37½ or 100 kva, and the number required of full-voltage motor starters. The important data relative to the various control, switchgear, and starting equipment are given. W. H. C.

100. High Pressure Pipelines Transport Valuable Helium at 2800 p.s.i. J. J. Reynolds. *Oil Gas J.*, 12.10.46, **45** (23), 84.—The two pipelines transporting helium from the Bureau of Mines plants are described.

The lines are 90 miles and 35 miles in length respectively, and are of 2⅜-in o.d., extra heavy seamless steel pipe coated with primer solution and coal-tar enamel and wrapped with asbestos. Pressure-welded joints were made.

The quicksand bed of the Canadian River was a major problem with the Amarillo–Enell line, two parallel lines 1500 ft in length and 500 ft apart were buried beneath the river bed. On the Shiprock–Gallup line overhead bridges were necessary to carry it over steep-sided dry creeks.

Tests capable of detecting the smallest leaks were made by pressuring the line with natural gas to 2800 p.s.i. reducing to 1000 p.s.i. and submerging in water, on 4-mile sections, throughout whole length. Special excess-flow valves were fitted at 5-mile intervals in case of a break developing, which were found to be effective in the condition existing in the presence of natural gas used for testing purposes remaining in the line after helium was admitted. G. A. C.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

101. Equivalent Heating Value of Refinery Fuels. W. L. Nelson. *Oil Gas J.*, 12.10.46, **45** (23), 111.—No. 114 in the Refiner's Notebook series lists the heating value of refinery fuels in two tables, from which three examples are worked out, including the equivalent in electricity, cracked gas, gasoline, heavy fuel, etc., of 1000 cu. ft of dry natural gas and 1 ton of coal. G. A. C.

102. Heat Absorption and Radiant Section. Refiners Notebook No. 112. W. L. Nelson. *Oil Gas J.*, 28.9.46, **45** (21), 111.—A chart is given from which the heat absorption of the radiant section of a tube-still furnace can be obtained. The composition of the chart and the method of its use are described. The left scale of the chart shows a factor which consists of the absorption rate in B.Th.U. per sq. ft, multiplied by tube diameter and divided by the centre-to-centre tube spacing. The figure is normally used by deciding, from the Refiners Notebook No. 111, 21.10.46, or other source, what allowable radiant absorption rate may be used, and then reading from the chart the percentage of the net heat developed that will be absorbed by the radiant section. W. H. C.

103. Operational Details of Talco's Waste-Water Disposal Plant. C. G. Rook. *Oil Gas J.*, 2.11.46, **45** (26), 75.—An average of 108,000 gal per day of water from the Mount Pleasant, Texas, plant of the Talco Asphalt and Refining Division, containing certain quantities of emulsified oils, sulphur compounds, caustic and wash waters, and other contaminants, has been successfully treated.

The water is neutralized with sulphuric acid to 7·0 pH, ferrous sulphate added to precipitate sulphides, the iron removed by 15% chlorinated lime slurry, and the floc produced enmeshes the suspended matter and oil in emulsion. Periodic tests are made to maintain the correct pH. The sludge is removed by a centrifugal pump and discharged through a 1-ton filter press, the cake being used for filler in the refining area. Average cost per 1000 gal of water treated is 15 cents. G. A. C.

Distillation.

104. Fractional Distillation of Ternary Mixtures. Part II. A. J. V. Underwood. *J. Inst. Petrol.*, 1946, **32**, 598–613.—In a previous paper (*J. Inst. Petrol.*, 1945, **31**, 111–118) the computation of the composition on any plate in a fractionating column for ternary mixtures was derived. In this Part, an alternative derivation of the equations is presented. Five examples are worked out to illustrate the use of the equations when the proportions of the 3 components vary between different limits. A. H. N.

105. Fractional Distillation of Multi-Component Mixtures—Calculation of Minimum Reflux Ratio. A. J. V. Underwood. *J. Inst. Petrol.*, 1946, **32**, 614–626.—By extending a method which has been applied to ternary mixtures, equations are derived by which the minimum reflux ratio for multi-component mixtures can be readily calculated when the fractionation between the key components is a sharp one, relative volatilities and molal reflux being assumed constant. Numerical examples are given to illustrate the method of calculation. A. H. N.

106. Questions on Technology. W. L. Nelson. *Oil Gas J.*, 5.10.46, **45** (22), 85.—A series of questions are answered, referring to pipe still transfer line temperature, cyclones, and viscosity of gasolines. Tables, formulæ, and diagrams fully illustrate the answers. G. A. C.

Cracking.

107. New Coking Unit Adds Versality, Increases Yields at Pure's Refinery. A. L. Foster. *Oil Gas J.*, 7.9.46, **45** (18), 74.—To meet any variations in present and immediate future product demands, the Toledo refinery of the Pure Oil Co. is installing

a complete new delayed coking unit. For some years past operations have been conducted in three combination C.H.P. units and an independent thermal reforming unit, and in 1944 a hydroforming plant and toluene recovery unit were added. These units and their operation are described and flow diagrams of two of them are shown. They are four-furnace assemblies with a reforming section, one light gas-oil section, one heavy gas-oil section and a viscosity-breaking section, all working in synchronism with the crude-topping section of each. The third unit has only three cracking coils. The capacities of the three units are, 9000, 11,000 and 10,000 brl/day of crude oil, operating for 50%, 40%, and 30% bottoms respectively.

When the new coking plant is ready, the flow of the crude oil feeds will be rearranged, so that all the charge is reduced to 30% bottoms for its feed. The new unit will add a great deal of flexibility of both product type and product quality to the refinery operations. The delayed coking plant will consist essentially of a double-coil heater, two coke drums, which are actually soaking drums, a fractionating column, three stream stripping columns, and various auxiliaries. The new unit is illustrated by means of a flow diagram, and its operation and range of products, from 30% reduced crude oil, are described. Each coke drum is sufficient for 24 hours production. Coke from a drum is removed by a hydraulic method, which employs a rotary cutter for cutting a 3-ft hole vertically, and uses a special head, with several rotary nozzles through which water at 1500 p.s.i. is ejected horizontally on to the cut walls, and traversing from bottom to top, cuts away the coke which falls out of the bottom man to an open car for removal and drying.

The overall yields are given for operations without and with delayed coking. The production of motor gasoline is 52·7% and 59·4%, and residual fuel 27·6% and 17·2%, of the crude oil charged respectively. The other main streams were kept at the same level. The A.S.T.M. clear octane numbers of the gasolines produced were 60 and 64 respectively. W. H. C.

108. Improved Fluid Catalytic Cracking Unit Reduces Maintenance Costs. B. J. Flock. *Oil Gas J.*, 5.10.46, **45** (22), 72.—A catalytic cracking unit to meet the requirements of small-scale refiners, designed by Universal Oil Products Co., is described.

Maintenance costs have been cut down, principally in the catalyst unit where erosion of cyclone separators, reactor system and line has been met by using wear plates and special cements. Hot catalyst will be carried in alloy or carbon-steel lines, layout being such as to obtain smooth flow. A unit has been in operation for 2 years, using 2–6 chrome alloy and carbon steel lines, without replacements. Operating pressures in the regenerator will be 10 p.s.i.g., thus reducing velocity and wear, and cyclone capacity has also been increased with the same object. Micro-spherical types of catalyst which do not possess the cutting power of the ground type are to be employed. Side-valves have been remodelled to give wider openings, and erosion reduced. It is expected that records of over 90% on-stream will be obtained with these improved units. G. A. C.

109. Commercial T.C.C. Operations on Partially Vaporized Charge Stock. H. D. Noll, A. W. Hoge and D. M. Luntz. *Oil Gas J.*, 19.10.46, **45** (24), 116.—The results of some concurrent flow operations after alteration to the reactor of the Socony Vacuum Oil Co. T.C.C. Commercial installation at Paulsboro', New Jersey, are presented.

The catalytic section of the unit is composed of a 16-ft i.d. solid-bed reactor and a 10-zone, 10-ft square solid-bed kiln with a nominal catalyst circulation rate of 100 tons per hr. Various vaporized and partially vaporized charging stocks are processed with concurrent flow of synthetic bead catalyst and oil through the reactor. The alterations to the reactor consisted of reversing the external oil piping, installing a vapour-catalyst disengaging device and revising the catalyst distributing system in the top of the reactor, and equipping the reactor with a fog nozzle for injecting non-vaporized charging stocks.

The results show that mixed phase concurrent T.C.C. cracking is practical and efficient, the concurrent flow results in better utilization of the heat content of the inlet catalyst and oil stream. Higher reactor temperatures for given oil and catalyst inlet temperatures are obtained, which results in higher octane number gasolines.

As for mechanical efficiency, carry-over of catalyst fines to the synthetic crude

tower is negligible, and the vapour catalyst disengager operates satisfactorily, and uniform coke laydown is achieved. The reactor seal legs in existing counter current T.C.C. units are adequate for concurrent operations. A flow-diagram is given, together with tables showing plant conditions, comparative once-through concurrent and countercurrent operations, and comparisons of commercial and pilot-plant T.C.C. cracking. G. A. C.

Alkylation.

110. Ethylation of Benzene in Presence of Solid Phosphoric Acid. V. N. Ipatieff and L. Schmerling. *Industr. Engng Chem.*, 1946, **38**, 400–402.—Phosphoric acid on kieselguhr (the so-called solid phosphoric acid) is an excellent catalyst for the alkylation of benzene with ethylene in continuous flow operation. The yield of ethylbenzene increases with increase in temperature and pressure; 80% conversion of ethylene in a single pass (at benzene space velocity of 2 cc./hr/cc. of catalyst) is obtained at about 325° C and 600 p.s.i., or at about 280° C, and 900 lb pressure. The ratio of monoethylbenzene to polyethylbenzenes increases markedly with increase in benzene-ethylene ratio; it is thus readily possible to obtain an alkylation product, over 90% of which is the desired styrene intermediate. The life of the catalyst is very satisfactory. A. W.

Isomerization.

111. Isomerization of Normally Liquid Hydrocarbons. No. 14. Modern Refining Processes. 1-Hexane. G. Armistead. *Oil Gas J.*, 28.9.46, **45** (21), 93.—During the war isomerization processes were primarily directed to the production of aviation components and the conversion of naphthenes to toluene. The Isomate process is described and discussed from the aspect of motor gasoline manufacture. It uses an aluminium chloride-hydrocarbon complex catalyst, promoted by anhydrous hydrogen chloride, and hydrogen is introduced to inhibit cracking at the high pressures employed (above 500 p.s.i.); it also serves to hydrogenate the catalyst complex and, by retarding the dehydrogenation action, thus lengthens catalyst life. A flow sheet of a naphtha isomerization unit and product fractionation is shown. The fresh feed should contain the least amounts of C_4 and C_7 hydrocarbons for the reasons given, which relate to the effects of $AlCl_3$ on the various hydrocarbons and types processed. In the Isomate process, both the feed and recycle gases are dried before admission to the HCl absorber, and are passed through a heater and are joined by a hydrogen stream before entering the reactor, in which a constant level of the catalyst complex is maintained. The $AlCl_3$-hydrocarbon complex catalyst has a specific gravity of about 1·5, and a viscosity somewhat greater than an SAE 50 lubricating oil. The reactor effluent, after passing through hot and cold settlers, goes to the HCl stripper, and then flows to caustic and water washers before entering the fractionating system. The effluent from the reactor remains comparatively free from $AlCl_3$, provided the $AlCl_3$ content of the complex is kept below 70%. The washed *iso*mate enters the depentanizing tower, from which overheads pass to the debutanizer, and the butanes therefrom are eliminated from overhead. The butanizer bottoms pass to the pentanes splitter, from which *iso*-pentane passes overhead and normal pentane from the bottom, which may be recycled. The depentanizer bottoms are passed to the hexane splitter, from which *iso*meric hexanes, including neohexane and di*iso*propyl, pass as overheads, and the bottoms go to the rerun tower from which the methylpentanes and normal hexane are taken as overheads; the latter may be recycled. The C_6 naphthenes and heavier fractions flow from the bottom. Typical operating conditions for isomerizing Mid-Continent hexanes are shown for (1) 35% pentanes and 65% hexanes, and (2) mixed hexanes, and a graph shows the effect on yields and quality of recycling ratios from 1 : 1 to 4 : 1. The products are discussed. Recycling gives best yields and highest octane-number products. Up to 93% of 91 octane number neohexane is formed at 4 : 1 recycle ratio. W. H. C.

112. Isomerization and Isoforming. 2-Pentane. G. Armistead. *Oil Gas J.*, 5.10.46, **45** (22), 80.—This is Part 15 of a series on modern refining processes, and Part 2 on isomerization and isoforming of pentane mixtures.

The feed passes first to the *iso*pentane tower, overhead from which initial *iso*-

pentane and lighter is removed. Normal pentane and heavier from the base of the tower pass to a rerun tower, where hexanes plus are removed from the bottom and reactor feed from the top. 0·5% of benzol is introduced with the feed to the reactor to reduce cracking and extend life of catalyst. HCl is removed from the hydrocarbons in a stripper and eventually C_4 is produced as overhead and *iso*pentane product as bottoms from a debutanizer. Hastelloy "B" or nickel reactor linings with water cooling on the outside of the vessel shell have greatly decreased corrosion caused by the aluminium chloride-hydrocarbon complex.

The isoforming process is a catalytic operation in which vaporized gasoline is passed over a silica-alumina catalyst at between 750° and 1000° F and at pressures of 5 to 10 p.s.i.g., using high space rates of from 4 to 40 b/v/hr.

Little has been disclosed about this process, but a feature is the yield-octane relationship, the octane number improving to a certain point and then degrades with increasing operation severity. A table illustrates this point. The process is applicable both to fixed-bed and fluid operation. The *iso*mate type of process can be operated at a cost of 0·7 to 1·0 cent per barrel of reactor feed, and when applying to straight-run paraffinic gasolines is competitive with the use of tetraethyl lead only on low-quality feed stocks. Isomerization processes may also find application with increase in octane levels and future emphasis on reduction of processing losses. G. A. C.

Chemical and Physical Refining.

113. Vacuum Distillation, Chemical Treating make Quality Lubricating Oils. A. L. Foster. *Oil Gas J.*, 28.9.46, **45** (21), 78.—A description is given of the plant used at the Houston refinery of the Sinclair Refining Co., and its operation with a South Texas crude oil for the production of five grades of lubricating oils which have exceptionally low Conradson carbon residues and low pour points. The plant consists of a battery of shell stills, three in parallel, for the removal of the 5% gasoline in the crude; and two in series, for stripping the virgin gas-oil; two furnaces, one vaporizer-stripper, atmospheric and vacuum fractionators, heat exchanging assemblies and a caustic neutralizing vessel. The crude charge flow takes up heat in the following sequence from: the gas-oil stream from the atmospheric tower, the heavy and extra heavy lube oil distillate vacuum streams, from the stripper-vaporizer, and from the vapours in the top of the vacuum fractionator. The stream then feeds the five shell stills as mentioned, and the flow from the last, goes to a furnace, is heated to 750° F and passed to the caustic mixer in which 25° Be caustic soda solution (0·35 lb/brl oil) is introduced, the mixed stream then flows to the atmospheric tower, from which overheads go to the gas-oil exchanger, and two side-streams to separate compartments at the head of the vapour-stripper, producing a non-viscous and a light lubricating oil distillates. The tower bottoms are pumped to the second furnace, and at 750° F enter the vacuum fractonator operated at 2–4 in mercury abs. This fractionator provides three side-streams and an overhead, viz., medium, heavy, and extra heavy lube distillates and an intermediate cut respectively. The residue from the base is called caustic bottoms. The five lubricating fractions are: 55–60, 100, 300, 1200 distillates and the heaviest fraction, each receive substantially the same treatment; but the heaviest is diluted with the 100 viscosity cut (50 : 50) before treating. The treatment given is by acid, neutralization hot-water washes and earth filtration. The amounts of acid used are 10, 15, 25, 30, and 40 lb/brl, and 1, 1·5, 2, 2·5, and 3 lb soda ash/brl, respectively. Filtration through fullers earth then follows. The diluted heavy fraction is steam stripped in a shell still, after neutralization and before earth treatment. The finished lubricating grades are: 55–60, 100, 300, 1200, and 2000 Pale, and have the following pour points and Conradson carbon values respectively: −65, −45, −25, −5, and 20° F; and 0·01, 0·03, 0·04, 0·08, and 0·28%. Three other grades, 200, 500 and 750 distillates are also made; these are not taken directly from the stills, but are blended from the distillates before treating. Their properties are also given. The Conradson carbon values are 0·02, 0·05, and 0·07%.

W. H. C.

114. Purification of Commercial Benzene by Azeotropic Distillation. J. Griswold and R. H. Bowden. *Industr. Engng Chem.*, 1946, **38**, 509–512.—Non-aromatic hydrocarbon impurities were separated from commercial benzene (coke manufacture) by

azetropic distillation with acetone. The approximate purity of the original benzene was 98·5%, and it is shown that benzene of approximately 99·7% or higher purity may be readily prepared by azeotropic distillation of the commercial material with acetone. A. W.

115. Benzoic Acid from Phosgene and Benzene. W. H. C. Rueggeberg, R. K. Frantz, and A. Ginsburg. *Industr. Engng Chem.*, 1946, **38**, 624–626.—The preparation of benzoic acid through the aluminium chloride-catalysed reaction between benzene and an excess of liquid phosgene was found to be superior to the previously known reaction between these reagents in such inert reaction solvents as carbon disulphide. The yields of benzoic acid in the process here described are dependent upon the reaction time and the molar ratios of aluminium chloride to benzene and phosgene to benzene, respectively. For a molar relation of phosgene to benzene to aluminium chloride equal to 3 to 1 to 1, a maximum yield of benzoic acid of 55–58% of theory, based on benzene, is obtained after a reaction period of 16 to 18 hr at 3 to 8 C. The by-product of the reaction is benzophenone. An increase of the aluminium chloride-benzene molar ration above unity accelerates the reaction, but does not increase the overall yield of benzoic acid. A decrease of the phosgene-benzene molar ratio below 3 to 1 reduces the yield of benzoic acid and increases the yield of benzophenone. The reaction between phosgene and benzene produces a grade of benzoic acid which is free of chlorine, but it has not yet been studied in pilot plant equipment.
A. W.

116. The Alkylation of Paraffins in the Presence of Homogeneous Catalysts. A. A. O'Kelly and A. N. Sachanen. *Industr. Engng Chem.*, 1946, **38**, 463–467.—Paraffins of normal and iso-structure can be alkylated in the presence of small amounts of halogen, nitrogen, or oxygen compounds as catalysts at temperatures ranging from 300° to 400° C and under pressures of the order of 3000 p.s.i. or more. Good examples of these homogeneous catalysts are chloroform, nitromethane, and trichloracetaldehyde. This type of alkylation produces a series of paraffinic hydrocarbons, some of which predominate, and represent primary alkylation products. These are not generally similar to those obtained from alkylation reactions using isomerization catalysts, and their structure corresponds to what might be expected as a result of the interaction between tertiary or secondary carbon atoms of paraffins and unsaturated carbon atoms of olefines. Alkylation of *n*-butane with ethene produces predominantly 3-methyl pentane; of *iso*butane with ethene, neohexane; of *iso*pentane with ethene, 3 : 3-dimethyl pentane; alkylation of *iso*butane with propene gives 2 : 2-dimethyl pentane with 2-methyl hexane and triptane in smaller yields. A. W.

Special Processes.

117. Western German Hydrogenation Plants. I. Anon. *Industr. Chem.*, 1946, **22**, 637–641.—The development of coal hydrogenation in Germany is briefly traced; this process was the country's most important liquid fuel source. The Gelsenberg and Scholven installations are dealt with in some detail. The operating pressures of the sump and vapour phases were 700 and 300 atm respectively. Gasoline production (15,000 tons/yr) commenced in 1937, the capacity being increased in 1942. Output was reduced in 1943 owing to bomb damage at the hydrogen plant. The gasoline produced had O.N. 72 (Motor) increased to 89 by the addition of 0·12% T.E.L. Bombing caused the abandonment of the plant in Sept. 1944. Hydrogen was produced mainly from water gas using a Fe–Cr catalyst, brief details of the production and purification procedures being given. The Scholven plant had an earlier beginning, and by 1940 production had attained 20,000 tons/yr. The plant was abandoned, due to bomb damage in Oct. 1944. A description of the process used in both plants is given. The overall yield at Scholven was 55% gasoline on dry ash-free coal. F. S. A.

118. Production of Benzyl Chloride by Chloromethylation of Benzene. F. C. Whitmore, H. A. Nottorf and others. *Industr. Engng Chem.*, 1946, **38**, 478–485.—Anticipated large-scale production of benzyl chloride, coupled with the shortage of toluene for this purpose, led to an investigation of the chloromethylation of benzene as a possible

source of benzyl chloride. Laboratory and pilot plant studies show the effects of hydrogen chloride addition at atmospheric pressure and 50–100 mm. mercury above atmospheric pressure, temperature, speed of agitation, speed of hydrogen chloride addition and total amount used, replacement of the zinc chloride catalyst with zinc oxide, iron and copper halides, preheating reactants before addition of hydrogen chloride, paraformaldehyde-benzene ratio, and reaction time. Distillation of benzyl chloride under various conditions has been studied. Results indicate that benzyl chloride can be prepared in yields of 70% or better, and that the zinc chloride catalyst can be regenerated and re-used repeatedly. A. W.

Metering and Control.

119. Graphical Method for Determining Maximum Flow in Systems using Centrifugal Pumps. B. C. Phenix. *Oil Gas J.*, 2.11.46, **45** (26), 72.—The method described is for studying installations where pressure drop is a limiting factor to increased production, and as an aid in the design of liquid flow systems.

An example worked out concerns the use of a stand-by pump, either in series or in parallel, in a system where one pump is used to supply liquid to two parallel systems, and a second example is provided by the problem of increasing the feed supply system capacity of a commercial unit whose flow sheet is depicted.

The given examples are fully discussed and worked out, in the latter case material and pressure-balance tests were also made. G. A. C.

Safety Precautions.

120. Evaluation of Barrier Creams. C. G. A. Sadler and R. H. Marriott. *Brit. Med. J.*, 1946, ii, 769–773.—Barrier creams, which if properly applied should have a thickness of 10–20 μ, have to be of four types, to afford protection against (i) irritant dusts, (ii) aqueous materials, (iii) solvents and oils, and (iv) substances that are both aqueous and oily. In view of the difficulty of organizing and interpreting clinical trials there is need for a laboratory method of evaluation. Eight creams were investigated both qualitatively and quantitatively. Of these, three had excessive pH values (over 9) which would cause them to be condemned. A description of the technique and apparatus for carrying out a permeability test developed by the authors is given. The material used is filter paper (Whatman No. 5), and results are given for the rate of penetration of both water and white spirit. It is concluded that such tests can give a good indication of the value of these substances; whilst creams giving good *in vitro* results may not always protect against dermatitis, those creams which failed the laboratory test were also found to break down in use. V. B.

Patents.

121. Patents on Refining Processes and Products. H. O. Folkins, assr to Pure Oil Co. U.S.P. 2,399,174, 30.4.46. *n*-Butane is cracked in the presence of oxygen and a phosphorus oxychloride.

P. P. Alexander, assr to Metal Hydrides Inc. U.S.P. 2,399,192, 30.4.46. Transformer oil is freed of moisture by passage through a bed of finely divided metal hydride.

V. Haensel and V. I. Ipatieff, assrs to U.O.P. Co. U.S.P. 2,399,224, 30.4.46. The bromine number of a cracked gasoline is reduced by treating the light portion with a phosphoric acid catalyst and the heavy portion with a combined silica-refractory oxide catalyst.

S. H. McAllister, J. Anderson, and W. E. Ross, assrs to Shell Dev. Co. U.S.P. 2,399,240, 30.4.46. An acid process of alkylating *iso*paraffins with olefins.

J. M. Musselman, assr to S.O.C. Ohio. U.S.P. 2,399,243, 30.4.46. A lub. oil additive obtained by the reaction between phosphorus sulphide and a fatty acid ester of a monoatomic alcohol.

C. L. Thomas, assr to U.O.P. Co. U.S.P. 2,399,261, 30.4.46. Aviation gasoline is obtained when a suitable cracked gasoline is passed over a silica-magnesia catalyst at 650°–1050° F under controlled conditions.

R. A. Frang, assr to United Gas Improvement Co. U.S.P. 2,399,340, 30.4.46. A polymerization inhibitor and oxygen are employed in the distillation of a heat polymerizable aromatic olefin.

J. P. Jones, assr to Phillips Petroleum Co. U.S.P. 2,399,353, 30.4.46. Liquid *iso*paraffins are obtained from low boiling *iso*paraffins by treatment with ethylene in the presence of hydrofluoric acid and finely divided nickel at 150°–350° F.

J. Kellett, M. M. Marisic, and A. A. O'Kelly, assrs to Socony Vacuum Oil Co. U.S.P. 2,399,354, 30.4.46. Paraffin hydrocarbons are isomerized by passage through a catalyst comprising inorganic oxides at 700°–1000° F under not less than 500 lb pressure.

M. P. Matuszak, assr to Phillips Petroleum Co. U.S.P. 2,399,368, 30.4.46. An olefin such as propylene and an *iso*paraffin such as *iso*butane are converted to propane and *iso*octane respectively by the hydrofluoric acid process.

F. T. Weiss and C. E. Arbuthnot, assrs to Shell Dev. Co. U.S.P. 2,399,413, 30.4.46. An aviation gasoline which contains from 1% to 15% hydrindene.

E. R. Butcher, assr to Gulf Research & Dev. Co. U.S.P. 2,399,464–5, 30.4.46. Stable liquid dust laying compositions which consist of low viscosity petroleum distillate (21 to 32° API) containing minor amounts of naphthenic acids, sodium salt of a sulphonated higher alcohol, oleic acid, and a germicide.

M. P. Matuszak, assr to Phillips Petroleum Co. U.S.P. 2,399,496, 30.4.46. Chromium oxide catalyst and hydrogen are employed to reduce the sulphur content of an oil at about 300° C and 250 lb.

A. G. Rocchini, assr to Gulf Research & Dev. Co. U.S.P. 2,399,510, 30.4.46. Cyclohexylamine oleate is added to a steam turbine oil containing a water insoluble alkyl phenolic antioxidant, in order to prevent corrosion during use.

W. S. Tyler, assr to Tide Water Associated Oil Co. U.S.P. 2,399,521, 30.4.46. Amorphous wax rendered oil free by solvent treatment of a centrifuge wax is added to oil free crystalline wax to inhibit its tendency to crack on chilling to low temperatures.

D. E. Carr, assr to Union Oil Co. U.S.P. 2,399,540, 30.4.46. Hot combustion gases from fuel mixed with finely divided metallic oxides are employed to crack hydrocarbon oils.

F. H. Amon, assr to G. L. Cabot Inc. U.S.P. 2,399,591, 30.4.46. The production of carbon black by the impingement process.

R. E. Burk and E. C. Hughes, assrs to S.O.C. Ohio. U.S.P. 2,399,662, 7.5.46. Benzol is alkylated with ethylene in the presence of hydrogen fluoride promoted by boron fluoride at about 200° F and 50 lb.

A. D. Green, S. C. Lane, and E. T. Marshall, assrs to Jasco Inc. U.S.P. 2,399,672, 7.5.46. Rubber-like products are obtained when an *iso*mono-olefin in an alkyl chloride diluent is polymerized at about −40° C in contact with a Friedal Crafts type catalyst.

E. J. Houdry and H. A. Shabaker, assrs to Houdry Process Corpn. U.S.P. 2,399,678, 7.5.46. A selected hydrocarbon is dehydrogenated using a preconditioned catalyst of the type which contains a polyvalent multivalent heavy metal oxide carried by surface active refractory metal oxide support.

M. H. Arveson, assr to S.O.C. Indiana. U.S.P. 2,399,717, 7.5.46. A process for coating particles of an adhesive material with a finely divided solid dust.

W. Hull, assr to American Cyanamid Co. U.S.P. 2,399,739, 7.5.46. β-Cymene is obtained from a monocyclic terpene by passage over a catalyst containing chromium oxide and copper oxide.

W. J. Mattox, assr to U.O.P. Co. U.S.P. 2,399,751. 7.5.46. A multi-stage process to produce aromatics from petroleum including cracking, deolefination and aromatization.

B. H. Shoemaker and B. L. Evering, assrs to S.O.C. Indiana. U.S.P. 2,399,765, 7.5.46. Pentane and hexane are separately isomerized.

G. B. Beacon, assr to The Texas Co. U.S.P. 2,399,780–1, 7.5.46. Toluene is produced by catalytic conversion of a mixture of benzene and higher boiling aromatics.

P. E. Hurley and J. B. Dunlap, assrs to Shell Dev. Co. U.S.P. 2,399,805, 7.5.46. An aviation gasoline of increased aromatic content is obtained when a straight run naphtha is thermally cracked in the pseudo-liquid phase in a multistage process.

R. E. Meyer, assr to Socony Vacuum Oil Co. U.S.P. 2,399,817, 7.5.46. The viscosity characteristics of an oil are improved by the minor addition of a neutral copolymer of a diolefin and a carbonyl compound.

J. D. Upham, assr to Phillips Petroleum Co. U.S.P. 2,399,837, 7.5.46. A method of recovering an aliphatic conjugated diolefin from a monosulphone.

J. G. McNab and D. T. Rogers, assrs to S. O. Dev. Co. U.S.P. 2,399,877, 7.5.46. C. F. Van Gilder and H. G. Schneider, assrs to S. O. Dev. Co. U.S.P. 2,399,878, 7.5.46. Processes for the manufacture of metal derivatives of alkyl phenols such as barium *tert.*-octyl phenol sulphide.

N. F. Myers, assr to S. O. Dev. Co. U.S.P. 2,399,883, 7.5.46. A C_4 fraction is acid treated and contacted with porous alumina prior to isomerization.

W. D. Seyfried and S. H. Hastings, assr to S. O. Dev. Co. U.S.P. 2,399,895, 7.5.46. A C_4 fraction is contacted with a catalyst comprising 80% MgO, 14% Fe_2O_3, 3% CuO at 1150° to 1300° F to effect dehydrogenation and isomerization.

D. A. Howes and E. W. M. Fawcett, assrs to Anglo-Iranian Oil Co. U.S.P. 2,399,927, 7.5.46. *iso*Paraffins are obtained by contacting normal hydrocarbons with a compound selected from the oxides and sulphides of metals of Group VI of the periodic table at 400° to 550° C and up to 250 atm.

I. Williams and F. W. Selfridge, assrs to J. M. Huber Corpn. U.S.P. 2,399,969, 7.5.46. An apparatus for carbon black manufacture by the impingement process.

E. R. Littman, assr to Hercules Powder Co. U.S.P. 2,400,012, 7.5.46. P. cymene is obtained by dehydrogenation of a monocyclic terpene using a palladium-active carbon catalyst.

J. A. Pierce and C. T. Steele, assrs to S. O. Dev. Co. 2,400,020, 7.5.46. A cracking catalyst is obtained by activating bentonite clay with oxalic acid.

W. L. Finley and J. H. Kirk, assrs to Sinclair Refining Co. U.S.P. 2,400,492, 21.5.46. A lub. oil additive consisting of the mixed calcium salts of alkyl phenol sulphides.

F. A. Kent and C. W. Patrick. U.S.P. 2,400,515, 21.5.46. Crude petroleum is purified and deodorized by treatment with hydrated lime then a chlorine acid.

C. S. Kuhn, Jr., assr to Socony Vacuum Oil Co. U.S.P. 2,400,520–1, 21.5.46. Propylene is polymerized in the presence of hydrofluoric acid to give higher boiling saturated hydrocarbons and unsaturated terpene-like hydrocarbons.

F. L. Mark. U.S.P. 2,400,563, 21.5.46. An asphalt composition comprising an oxidized asphalt, mineral filler and kiln dried deatomaceous earth.

H. L. Norway, assr to The Bastian Blessing Co. U.S.P. 2,400,569–70, 21.5.46. A design of a dispensing system for liquified petroleum gas.

H. G. Smith, T. L. Cantrell and J. G. Peters, assrs to Gulf Oil Corpn. U.S.P. 2,400,611, 21.5.46. An improved anti-rust additive for a turbine oil is a homogeneous blended mixture of a polyvalent metal salt of N-alkyl phthalamidic acid and amine addition salts of 3-methyl butyl 2-ethyl-hexylphosphoric acid with primary fatty amines and secondary cyclohexyl amines respectively.

L. C. Huff, assr to U.O.P. Co. U.S.P. 2,400,645, 21.5.46. A device for separating gases and solids such as encountered in fluid catalytic cracking units.

T. A. Petry and H. K. Holm, assrs to Secony Vacuum Oil Co. U.S.P. 2,400,654, 21.5.46. Toluene is separated from a complex mixture with non-aromatics by distillation of the mixture with aqueous methanol.

U. Tsao, assr to The Lummus Co. U.S.P. 2,400,669, 21.5.46. A process of isomerizing paraffin hydrocarbons in the vapour phase using anhydrous $AlCl_3$ and including recycling of the catalyst.

G. B. Arnold, assr to The Texas Co. U.S.P. 2,400,732, 21.5.46. A multi-stage process in which a naphtha is extracted with water in the liquid phase under pressure at 500°–600° F to separate aromatics following with catalytic isomerization of the paraffins in the raffinate and recycling a portion of the naphthenes obtained by removal of the isomerized paraffins.

C. W. Watson, assr to The Texas Co. U.S.P. 2,400,795, 21.5.46. A method of preparing gasoline rich in aromatics and paraffins from straight-run and cracked gasoline by dehydrogenation of the former and hydrogenation of the latter concurrently in the same reaction zone.

G. B. Arnold, assr to The Texas Co. U.S.P. 2,400,802, 21.5.46. Toluene is separated by solvent extraction of cracked gasoline employing water containing 5–25% olefin glycol at 420° to 525° under pressure.

W. A. Schulze and C. J. Helmers, assrs to Phillips Petroleum Co. U.S.P. 2,400,843, 21.5.46. Aviation gasoline is obtained by subjecting cracked gasoline to a multi-stage catalytic process employing bauxite and synthetic silica-alumina catalysts.

G. R. N.

PRODUCTS.

Chemistry and Physics.

122. Surface of Solids XVII. A First- and Second-Order Phase Change in the Adsorbed Film of *n*-Heptane on Graphite. G. Jura, W. D. Harkins, and E. H. Loeser. *J. Chem. phys.*, 1946, **14**, 344.—The films of *n*-heptane formed by adsorption on the surface of graphite between 25° and 40° C exhibit a first- and a second-order phase transition. The first-order transition occurs between the gaseous and liquid expanded phases. The second-order transition occurs between the liquid expanded and liquid intermediate phases, and between the gaseous and liquid intermediate phases above the critical temperature. Since the behaviour of the film is the same as that observed with insoluble films on aqueous subphases, the nomenclature for the latter is used. The critical constants for the gaseous film were determined as: temperature, 31° C; area, 400 A per molecule; and film pressure, 1·05 dyne cm^{-1}. These values are different from those found for *n*-heptane on ferric oxide, which shows that the solid as well as the gas plays an important rôle in the determination of the adsorption isotherm. The heat of transition for the first-order change is estimated as $13{,}000 \pm 5000$ cal. $mole^{-1}$ at 25° C. It is found at corresponding temperatures, within this large experimental error, that the heat evolved in the first-order transition is the same on graphite and ferric oxide. J. T.

123. Molecular Weight—Physical Property Correlation for Petroleum Fractions. F. W. Mills, A. E. Hirschler, and S. S. Kurtz, Jr. *Industr. Engng Chem.*, 1946, **38**, 442.—Several correlations of molecular weight with physical properties are presented which cover the ordinary range of petroleum fractions. For fractions of 70–300 mol. wt. (gasolines, kerosenes, light lubricating oils) boiling point and gravity are employed; the correlation gives good results for pure hydrocarbons of various types (average deviation 2·4% for 134 compounds) as well as for petroleum cuts. For lubricant fractions of 240–700 mol. wt., correlations are described for viscosity at 100° with viscosity at 210° F; the former are not, in general, applicable to pure hydrocarbons, but give good results for many lubricant fractions, with the exception of two highly naphthenic distillates (Gulf Coast and Californian) above 350 mol. wt. With the use of a correction, the viscosity–gravity correlations give good results for these oils also. The correlation of viscosity at 100° with viscosity at 210° F is in approximate agreement with the data for pure hydrocarbons of various types, and gives good results for all types of petroleum fractions for which data are available. For petroleum waxes melting point and refractive index at 80° C are employed; the correlation is in

good agreement with the data for the *n*-paraffins, as well as for petroleum waxes of various types. A. W.

124. Molecular Volumes of Mononuclear Aromatic Hydrocarbons. N. Corbin, M. Alexander, and G. Egloff. *Industr. Engng Chem.*, 1946, **38**, 610–611.—The molecular volumes of 1-phenylalkanes and 2-phenylalkanes at any given fraction of the critical temperature, are linear functions of the number of carbon atoms. Molecular volumes of fourteen homologous series of mononuclear aromatic hydrocarbons at 20° C are also linear functions of the number of carbon atoms. Both of these relationships may be expressed by equations of the form :—

$$M/d = V = a + bn.$$

The constants a and b are simple functions of the reduced temperature (T_R). These functions may be expressed by equations of the form :—

$$a(\text{or } b) = K + pT_R + qT_R^2.$$

A. W.

125. The Tendency to Smoke of Organic Substances on Burning. Part I. A. E. Clark, T. G. Hunter, and F. H. Garner. *J. Inst. Petrol.*, 1946, **32**, 627–642.—The British incendiary bomb, used in very large quantities by the R.A.F. for the bombing of German towns and cities, was essentially a 30-lb bomb filled with a special benzol gel together with white phosphorus. The benzol gel filling produced on burning a large amount of black carbon smoke which obscured the target, and resulted also in an appreciable portion of the filling being wasted as unburned carbon. In addition, copious white smoke produced by the burning phosphorus increased the obscuring effect over the target. The possibility of replacing this benzol gel-phosphorus combination with a smokeless filling of a satisfactory nature was therefore investigated. Toward this end the smoking tendency of a large number of organic compounds was assessed by flame-height measurements in a special lamp based on the I.P. smoke lamp. A burning organic substance has a flame-height at and above which smoking occurs, and this height is a measure of the tendency to smoke. A new form of lamp was devised to measure flame-heights, from about 9 to 450 mm, of liquid compounds burning freely in air. A wide range of hydrocarbons, alcohols, ketones, esters, and nitro-compounds was examined—115 compounds in all. In general, a compact molecule was found to give a smoky flame. The order for increasing tendency to smoke for hydrocarbons is: *n*-paraffins (in which increased chain length or chain branching gave increased smoke), naphthenes, olefines, and aromatics (in which appreciable aliphatic side chains on the benzene ring appeared to give no marked reduction in smoke).

In general, increased oxygen content of an organic compound resulted in decreased smoking tendency and compounds such as methyl acetate containing high percentages of oxygen only smoked at very large flame-heights. Some compounds, such as allyl alcohol, although having appreciable oxygen contents, had relatively high smoking tendencies, due to the nature of the carbon-hydrogen portion of the compound. Of the aliphatic alcohols, the tertiary compounds were more smoky than the primary compounds. This also applied to nitro-paraffins. For each set of isomeric aliphatic esters, the flame-height at which smoking began increased with the chain length attached directly to the carboxylic carbon atom. At equal oxygen content, the general order for increasing tendency to smoke was: *n*-primary alcohols, *n*-primary nitro-paraffins, propionates, acetates, lactates, and formates, although the order varied slightly for different oxygen contents. A. H. N.

126. The Scattering of Electrons by Hydrocarbon Films. J. Karle. *J. Chem. phys.*, 1946, **14**, 297.—Several formulæ expressing the intensity of electron scattering are derived for a variety of orientations of hydrocarbon films on a solid surface. From these formulæ intensity contour maps may be constructed for arbitrarily chosen models. These maps are helpful for the determination of the structure of a film and are prepared for future publications. J. T.

127. Relation between Bond Force Constants, Bond Orders, Bond Lengths, and the Electronegativities of the Bonded Atoms. Walter Gordy. *J. Chem. phys.*, 1946, **14**, 305.—A relation of the form $k = aN(x_A x_B/d^2)^{\frac{1}{4}} + b$ is found to hold for a large number of diatomic and simple polyatomic molecules in their ground states. k is the bond-stretching force constant, N the bond order, x_A and x_B are the electronegativities of the bonded atoms, and d is the bond length. The average deviation of k calculated from k observed for 71 cases is 1·84%. If k is measured in dynes/cm $\times 10^{-5}$ and d in Angstrom units, in the case of stable molecules exhibiting their normal covalencies, except those in which both bonded atoms have only one electron on the valence shell, a and b have the values 1·67 and 0·30, respectively. For diatomic molecules of the alkali metals, Na_2, NaK, etc., a and b are 1·180 and −0·013, respectively; for hydrides of elements having a single electron in the valence shell, 1·180 and 0·040, respectively; and for diatomic hydrides of elements having two to four electrons in the valence shell, 1·42 and 0·08, respectively. Numerous applications of this relation are made and certain exceptions pointed out. J. T.

128. Pressure Dependence of Accommodation Coefficients. I. Amdur. *J. Chem. phys.*, 1946, **14**, 339.—An explanation of the pressure dependence of accommodation coefficients of gases on metals is given by assuming that these coefficients vary linearly with the fraction of the surface covered with absorbed gas, and that the accommodation coefficient has a negligibly small value a_0 on a gas-free surface and an asymptotic value a_∞ on a saturated surface. The assumptions lead to an accommodation coefficient isotherm which reproduces the pressure dependence of 119 values of accommodation coefficients for the gases on platinum with an average absolute deviation of 1·5%. J. T.

Analysis and Testing.

129. Molecular Weights in Practice and Theory. (1) Practice. A. V. Brancker. *Petroleum*, 1946, **9**, 235.—A review of methods used in determining molecular weights. K. C. G. K.

130. Crankcase Oil Ageing Tests (1). M. Freund. *Petroleum*, 1946, **9**, 226.—This article is the first of three dealing with long-term service investigations made on fast-running diesel engines. A thorough examination has been made of the changes occurring in crankcase lubricating oil, and an attempt made to determine the part played by sludge in relation to the properties of the used oil.

New and modified test methods have been devised to determine the amount of foreign solid matter, hard asphalt, and petroleum resin present in the same sample, as well as to determine neutralization number and acid tar number.

Although test results must be evaluated very carefully, it is shown that to characterize oil ageing during service it is sufficient to know the properties of undiluted crankcase oils such as viscosity, neutralization number, hard asphalt content, and solid matter.

A table of inspection data is included for the effect of sludge removal on diesel crankcase oil characteristics after varying periods of service. K. C. G. K.

131. The Application of Spreading Measurements on Oil Tests. N. E. M. Hagethorn and F. H. Stieltjes. *J. Inst. Petrol.*, 1946, **32**, 587–597.—The expanse of the surface of an oil duplex film in a Langmuir trough is a measure of the quantity of surface active compounds present in the mineral oil. Using a paraffin-wax trough, slide, and barrier in the usual manner, the area of the oil film is measured and plotted against the pressure on the barrier. Extrapolation to zero pressure gives the specific spreading value. Cable oils centrifuged from different parts of the cable and subjected to different temperatures exhibited differences in specific spreading values, although no conclusions could be drawn from their power factors about their differences in composition. Similarly spreading values could be correlated with oxygen absorption of an oil on oxidation, with degree of purification of another oil by charcoal or clay and with hydrogenation which remove the active components. A. H. N.

132. Normal Heptane as a Reference Fuel in Measuring Anti-knock Quality of Gasoline. H. M. Trimble and A. W. Suderman. *Oil Gas J.*, 2.11.46, **45** (26), 66.—Results of a

series of tests to evaluate 99% normal heptane as a road test reference fuel are given.

Among the advantages of using pure compounds as reference fuels are ease of reproduction of pure materials, less sensitivity to engine conditions than are impure fuels containing a more sensitive compound or impurity, and results are easy to interpret because of the close relationship of pure products. The cost of primary reference fuels has prohibited their use for road-test and other full-scale work. Secondary reference fuels are used in practice and various errors may be introduced.

A table gives some important characteristics of 99% normal heptane and primary and secondary antiknock reference fuels. Road tests were conducted with 2 middle-priced and 3 popular-priced cars. Blends of 99% normal heptane in F-6 reference fuel were used to rate specific A.S.T.M. (F-2) octane number mixtures of A-6, C-12, and F-4 secondary reference fuels, and blends of C-13, F-6 and M-4 secondary reference fuels. It was concluded that road antiknock rating based on pure-type reference fuels will be numerically different and higher than with secondary reference fuels using the present rating system.

Normal heptane of 99% purity in F-6 reference fuel will give closer checks with primary reference fuel values than will the secondary type reference fuels; and variation in quality and antiknock value will be greatly minimized by the use of pure type reference fuels. The results are tabulated. G. A. C.

133. Viscosity Characteristics of Greases. 3. Type and Concentration of Soap. V. P. Varentzov. *Petroleum*, 1946, **9** (10), 232. (From the symposium on the Viscosity of Liquids and Colloidal Solutions, *Academy of Sciences of the U.S.S.R.* 1941, 1, 197–210).—See Abstract No. 1054 (1945).

Gas.

134. Questions on Technology. W. L. Nelson. *Oil Gas J.*, 12.10.46, **45** (23), 83.—Questions on the thermal conductivity of natural gas, its heat content, and on fuel consumption of a diesel engine operating at 50 hp. are answered, the text being illustrated by labels and a chart. G. A. C.

Gas Oil and Fuel Oil.

135. Combustion Testing Complications. Factors Difficult to Evaluate Determine Real Efficiency. J. W. Schulz. *Fueloil & Oil Heat*, Aug. 1946, **5** (4), 47–50.—Describes in a simple manner combustion characteristics, the operation of and improvements by which economies in operating domestic oil-fired boilers or furnaces may be obtained, and what is meant by overall efficiency of a heating installation. The tests carried out for evaluating the efficiency by means of a stack thermometer and CO_2 draft gauge tester are described, and the results of good or poor combustion are discussed. A stack loss chart is presented and the basis of its construction and the way it is used are described. The chart is based on the gross calorific value and continuous burning of a No. 2 fuel oil, and relates stack temperature, and per cent CO_2 in the flue gases, to per cent excess air, and stack loss, *i.e.*, the loss of heat in terms of total heat in the oil. The limitations of such charts are emphasized, and it is pointed out that different charts and tables may give different results, as they are not all constructed on the same basis, and also that tables and charts are usually based on complete combustion and continuous operation of the burner, whereas in actual practice the burning is usually intermittent. W. H. C.

136. Which Kind of Efficiency? According to Basis Used, Same Job is 58% or 87% Efficiency. J. W. Schulz. *Fueloil & Oil Heat*, Sept. 1946, **5** (5), 46.—(*Continuation of paper in Abstract No.* 135).—Examples are given of the different efficiency results reported by three experts, through their different method of estimating the efficiency from an identical CO_2 test and stack temperature reading from a test run on a heating installation. Their methods of evaluation are given and the subject is discussed. The meaning of "efficiency" starts with the meaning of the calorific value of the fuel oil.

In the U.S.A., the standard used is the high heating value of the oil, which includes

the latent heat of condensation of the water vapour in the combustion products. In Great Britain and other countries, other values are used, such as :—the lower, net or available heat values, which do not include the latent heat of the water vapour produced. The overall efficiency of boilers or water heaters, by the evaporation test, and such terms as the absorption efficiency, preventible stack loss and avoidable stack loss, are described and the conditions under which they are determined are explained. The effect of non-continuous burning as applied to boilers and water heating installations is discussed and illustrated in a graph, showing the effect of on–off cycling on overall efficiency, and a table shows similar data when using standard and light firebrick furnace linings. Because the overall efficiencies of boilers and furnaces can be estimated only with difficulty on actual installations, a conservative course is recommended to those who report efficiencies derived from CO_2 and stack temperature readings. Such, if properly taken and reported, are indisputable. Where, in addition, such figures as "estimated stack loss," etc., are recorded, the manner of their derivation should be stated. It is not wise to report such "efficiencies" for intermittently fired installations unless circumspect allowance has been made for the decrease in efficiency that results from non-continuous operation of the unit.

W. H. C.

137. Fuel Oil and Oil Firing. G. J. Gollin. *Heating Ventilating Engr*, 1946, **20** (230), 78.—The importance of oil and air control in fuel oil burning systems is discussed in this article. Devices for maintaining constant viscosity and constant pressure of the fuel are described and illustrated. Of equal, if not greater importance, is the control of air for combustion. It must be admitted to the oil cloud in the correct quantities at each stage with the correct directional flow. The direction and quantity of air relative to the spray are critical and primary and secondary air must be carefully controlled. Types of combustion chambers giving desired effect are illustrated.

J. N.

138. Fuel Oil and Oil Firing. G. J. Gollin. *Heating Ventilating Engr*, 1946, **20** (231), 101.—The principal four types of fully automatic self-contained oil-burning units are dealt with in this article. They are : (*a*) Pressure jet atomizer ; (*b*) medium pressure air atomizing ; (*c*) horizontal rotary cup plus low pressure air ; and (*d*) vertical rotary cup plus low pressure air.

Of these four (*a*) is the most widely used in U.S.A., U.K., and Europe for three main reasons : (1) Few parts are required and construction is simple ; (2) provided oil is delivered to the nozzle at constant pressure and temperature, no metering device other than the nozzle is necessary ; (3) easy ignition by electric spark. This type is described in detail followed by briefer description of types (*b*), (*c*), and (*d*). J. N.

139. Fuel Oil and Oil Firing. G. J. Gollin. *Heating Ventilating Engr*, 1946, **20** (229), 12.—The seventh article of this series continues the description of factors to be taken into account in the design of oil-burning installations.

Storage tanks should be vented to allow air to pass out when the tank is being filled and to prevent a vacuum being formed in the tank when it is being emptied. Each tank should be equipped with devices to indicate its contents, and two types are described.

For safety purposes, to guard against possible leaks, tanks should be installed in oil-tight pits of sufficient capacity to accommodate, with a margin, the contents of the tank.

Where a heavy viscous grade of oil is used, it must be warmed to keep it at a viscosity at which it is pumpable. Tanks with heating coils should be carefully insulated.

Filters for oil burning installation can generally be divided into two classes :—(*a*) Coarse ; (*b*) Fine. The coarse filters protect pumps and heaters, and the fine filters, metering, orifices and atomizers. J. N.

140. Fuel Oil and Oil Firing. Advantages and Defects of the Intermittent Burner. G. J. Gollin. *Heating Ventilating Engr*, 1946, **20** (232), 150.—In the tenth article of this series the advantages and disadvantages of self-lighting intermittent burners are discussed, and various types of automatic control systems are described.

The self-lighting intermittent burner can be adjusted and left running for months with the certainty that the oil throughout, and air supply, will remain reasonably

constant, and that a good standard of efficiency will be maintained. It has, however, to be adjusted initially to give smokeless combustion under the worst conditions under which it is expected to operate and therefore may not give maximum efficiency at every point throughout the whole operating range. Another disadvantage lies in the drop in mean efficiency due to idle periods.

Automatic controls perform two main functions. One, to match the heat input by the burner to the load demand, and two, to ensure that the burners will not work unless all the controls are in good working order and to shut off the fuel in the event of flame failure.

The systems are electrically operated, thermostats and flame sensitive devices being used to open or close circuits controlling the several units involved. J. N.

Lubricants.

141. Principles of Filtration 3. Filters. A. H. Stuart. *Petroleum*, 1946, **9**, 233.—Magnetic filters will not retain iron oxide or non-magnetic matter occurring in used oil. Electrostatic methods are very slow and suitably only for batch treatment. The pros and cons of adsorbent filters are discussed. Polar oils contained as additives may be removed by such filters.

In any filter, the finer the particles retained the greater will be the pressure drop and for any given size of filter the slower the rate of flow. A by-pass filter may be necessary where insufficient space is available to provide a filter passing oil at a sufficient rate.

In such cases the main part of the oil from the pump passes to the engine-bearings while the remainder returns via the filter to the sump or other oil container.

Drawbacks to this arrangement are mentioned. K. C. G. K.

142. Lubrication Vade Mecum. Addendum (8). E. W. Steinitz. *Petroleum*, 1946, **9**, 242.—This concludes the Addendum and deals with Pneumatic Rammers, Pneumatic Tools, and Thrashing Machines under section XI. Under Section XII lubrication as applied to the Woodworking Industry is considered under the headings of Veneer Cutting Machines, and Frame Saws. K. C. G. K.

143. Machinery of Plain Bearings with Single-Point Tools 3 (1) Bearing Characteristics. P. Grodzinski. *Petroleum*, 1946, **9**, 244.—Conditions necessary to obtain a smooth bearing surface are indicated. Cross grooves should be nearly eliminated to give the best conditions for fluid film lubrication. The fine boring of bearing surfaces is stated to have the following advantages; 1. Bearing clearance is measurable and predetermined; 2. Initial wear is reduced; and 3. The supporting area is large, even in the newly assembled state. The points raised are dealt with in the article. The question of the necessity of using diamond tools for finishing lead bronze bearing is also discussed. K. C. G. K.

144. Continuous Process for Aluminium Greases. H. G. Houlton, M. Sutton, and H. W. Bevarly. *Oil Gas J.*, 19.10.46, **45** (24), 127.—Plant data for a continuous process manufacturing aluminium grease at the rate of 1500 to 2000 lb per hr is presented.

An oil-and-soap slurry, made under 22–26-in vacuum, is pumped at 1500 lb per hr through a steam-heated Votator to dissolve the soap, then through a cooling Votator to cool the grease. The cooled grease passes into insulated gel tanks of 5500 lb capacity, where the grease is uniformly gelled, isothermally, and then pumped through a worker to break down to constant consistency, no intermixing being necessary.

The slurries were prepared under vacuum to prevent entrainment of air. Both the heating and cooling Votators are fitted with temperature controls. Operating conditions are dependent on source and refinery treatment of the oil and type and manufacture of soap. A uniform product is obtained by separating the cooling and gelling stages, the high film coefficient of the Votator ensuring this.

Visual tests of surface sheen, brightness, transparency, and float are made on gelling conditions. Figures show the effect of blending at heavy oil with a light one on critical temperature and bleed tendency, the properties of greases made from

commercial aluminium stearate soaps; and the relation of pumping pressure and Votator power loads to critical temperature. G. A. C.

Special Hydrocarbon Products.

145. Crystallography of Waxes 3 (3) Photomicrographs. L. Ivanovszky and J. H. Wredden. *Petroleum*, 1946, **9**, 241.—Four photomicrographs of crude Russian ozokerite, white Russian ozokerite, yellow Roumanian ozokerite and white ozokerite R.K. respectively. K. C. G. K.

146. Solubilization of Insoluble Organic Liquids by Detergents. J. W. McBain and P. H. Richards. *Industr. Engng Chem.*, 1946, **38**, 642–646.—Solubilization is attributed to incorporation of the insoluble substance within and upon the colloidal particles or micelles of the soap or detergent. This paper presents a first attempt at a systematic investigation of the characteristics of an insoluble organic substance that determine the extent to which it is solubilized. A number of cation-active and anion-active detergents have been used with a series of aliphatic and aromatic hydrocarbons, in addition to a number of polar compounds. Substances of very low molecular weight are freely solubilized, but the extent of solubilization falls off rapidly with increase in molecular weight or molar volume. Polar compounds are more readily solubilized than hydrocarbons. Although in general the various detergents show parallel behaviour, differing only in degree of solubilizing power, and the cation-active detergents are generally better solubilizers than the anion-active detergents, there are numerous specificities and influences of structure, both of the detergent and of the material being solubilized. Soaps and detergents that have in common the twelve-carbon paraffin chain differ greatly in solubilizing power, each favouring particular classes of chemical substances. A. W.

Derived Chemical Products.

147. Rust Preventive Oils. G. D. Pilz and F. F. Farley. *Industr. Engng Chem.*, 1946, **38**, 601–609.—Rust-preventive oils, composed of polar organic compounds in mineral oils, have been employed extensively in film applications for the temporary protection against rusting of iron and steel parts during manufacturing operations, storage, shipment, and use. The condensation of moisture in droplets on such oil-coated steel parts produces a dynamic system composed of water, oil film, and metal. A study of the contact angles formed by such a system where a drop of water rests on a horizontal oil-coated steel panel has established a relationship between contact angles and rust-preventive ability. A mathematical analysis of the forces involved in the spreading of a water drop on a rust-preventive oil film has shown that the equilibrium surface tensions of the water and oil, and their interfacial tension, are the major factors determining the magnitude of the contact angle. These findings are in agreement with the theory of rust prevention which postulates orientation of the polar organic additive at the oil-metal interface and establishment thereby of a barrier to normal mode of entry of the rusting agents—oxygen and water.

Contact angles were measured by a microscope fitted with a goniometer eyepiece; they have been employed in determining that solubility in water is of prime importance among the physical properties of rust-preventive additives, and have found application in controlling plant production of rust-preventive oils. A. W.

148. Colloidal Carbon. W. H. Cadman. *T. Roy. Soc. Arts*, 1946, **94**, 464.—See Abstract No. 1449 (1946).

Miscellaneous Products.

149. Furniture Polishes. M. A. Lesser. *Soap*, 1946, **22** (10), 130.—Twenty-four formulæ for various furniture polishes are given.

Furniture polishes are provided as liquids or pastes, the liquid products being broadly classified as oil and emulsion polishes, and the pastes as wax-solvent mixtures and wax emulsions.

Carnauba, bees, bleached montan ceresin, and paraffin waxes are often incorporated into polishes. Straight oil polishes, consisting mainly of mineral oil, are easiest to produce. Oils are sometimes blended, and various combinations of oils and solvents are used. Paste-type furniture polishes, although not produced in such volume, require more labour in application, but give good durable finishes.

They consist essentially of waxes thinned or pasted with solvents such as turpentine and petroleum naphtha. G. A. C.

Engines and Automotive Equipment.

150. Note on the Use of Ceramics in Gas Turbine Design. S. W. G. Foster. *J. R. aero. Soc.*, 1946, **50**, 893.—Reviews the developments in Germany during the war of the use of ceramic materials in turbine design. The Siemens turbine running at 30,000 r.p.m. had a diameter of approximately 31 in with blading of sintered alumina. The high temperature strength of this material is impressive and comparisons with silicon carbide, Ardostan (Kaolin and soapstone), Calit (soapstone), and Steatite are made. Porcelains and glasses suffer from poor thermal shock resistance. A brief description is given of Dr Schmidt's method of cooling rotor blades.

The original references are: C.I.O.S. file No. 30, 66 and C.I.O.S. File No. 31, 22. I. G. B.

151. On the Steady Flow of a Gas Through a Tube with Heat Exchange or Chemical Reaction. P. Chambre and Chia-Chiao Lin. *J. Aero. Sci.*, 1946, **13**, 537.—This paper is concerned with a simple discussion of gaseous combustion through a tube and related phenomena involving hydrodynamic, thermodynamic, and chemical considerations. It is also indicated how the discussion can be conveniently developed into a treatment from the point of view of microscopic chemical kinetics. Indeed, some interesting results are already obtained without such an extension. For instance, when there is no chemical reaction, it is found that for the range of Mach Numbers of flow $1/\sqrt{\gamma} < M < 1$ in the subsonic region, the temperature of the gas is actually decreasing while external heat is being added. It is also shown that by continuous heating both subsonic flows and supersonic flows will eventually approach the sonic state. When the system undergoes chemical or physiochemical transformations, the situation is much more complicated. In extreme cases, it is possible that the temperature of the mixture decreases continuously for all Mach Numbers while heat is being evolved by the transformation. The results apply successfully to the phenomenon of detonation. A general discussion of the propagation of flame front in a tube is then made, both in the region of slow burning and in the region of detonation. I. G. B.

152. The History of the Opposed Piston Marine Oil Engine. W. Kerr Wilson. *Trans. Inst. mar. Engrs.*, 1946, **58**, 172.—A survey of the opposed piston engine development since 1874 indicates that most features of opposed piston mechanisms were disclosed in the years preceding 1900.

In this article, the author describes, in some detail, patents taken out on opposed piston engine design from 1874 onwards. Some of the principal difficulties encountered and overcome are discussed and reference is made to several ingenious designs produced after 1900, including double acting, swash plate and free piston arrangements. J. N.

153. The 2000 H.P. Hercules. Anon. *Aeroplane*, 1946, **71**, 542.—Latest variant of the Bristol sleeve-valve radial engines is the Hercules 230 and its civil counterpart, the Hercules 730. Strengthening of certain components has enabled the output to enter the 2000–2500 h.p. range, the engine showing an increase in maximum power of 310 h.p. over the previous series on 100/130 grade fuel without methanol/water injection. With higher-grade fuels a target of 2500 h.p. has been set for further development work. Leading particulars are as follows:—

Dimensions: Diameter over cylinders, 52 in; length overall 69·5 in.

Weights: Bare (dry), 2,060 lb; baffles and exhaust, less tail pipe, 177 lb.

Performance : Maximum power for take-off, 2000 h.p. at 2800 r.p.m. + 12 lb/sq. in boost at sea-level: maximum emergency power, 2055 h.p. at 2800 r.p.m. + 12 lb./sq. in boost at 3500 ft; maximum continuous rich mixture cruising power 1605 h.p. at 2400 r.p.m. + 8 lb/sq. in boost at 4750 ft. Maximum continuous weak mixture cruising power is 1305 h.p. at 2400 r.p.m. + 3·5 lb/sq. in boost at 11,500 ft. Fuel consumption at 1305 h.p. and 2400 r.p.m. is 0·428 lb/h.p./hr or at 760 h.p. and 1400 r.p.m. it is 0·411; average oil consumption is 1·0 gal/hr and 0·35 gal/hr respectively. I. G. B.

154. A New British Engine in Paris. Anon. *Aeroplane*, 1946, **71**, 557.—A new 5·3 litre flat six engine, designed and built by Roy Fedden, Ltd., is being exhibited for the first time at Paris. Designed for thin wings, it can be accommodated entirely inside a 14 in thick wing. Use is made of sleeve valves of nickel-manganese-chromium alloy high expansion steel. The engine uses direct fuel injection equipment metering the fuel direct to the inlet ports. Leading particulars given are :—

Bore 4·3 in : stroke 3·75 in ; compression ratio 8 : 1 using 90 octane fuel.

Dimensions : width, 31·7 in (excluding baffles) ; length (without starter), 30·25 in ; height, 12·25 in (plus a small blister over the fuel injection pump of 2·5 in).

Weight : 310 lb without starter, generator, reduction gear, baffles, or exhaust system.

Performance : ungeared, 160 h.p. for take-off at 2750 r.p.m. ; cruising, 123 h.p. at 2500 r.p.m. ; geared, 185 h.p. for take-off at 3400 r.p.m. ; cruising, 150 h.p. at 3150 r.p.m. ; fuel consumption, ungeared, 0·46 lb/b.h.p./hr geared 0·47 lb/b.p.h./hr. I. G. B.

155. Aircraft in the Paris Show. Anon. *Aeroplane*, 1946, **71**, 614.—Four countries show aircraft of various sorts including aeroplanes, helicopters, and gliders.

Britain : Products by A.W.A., Avro, Bristol, Gloster, Fairey, Handley Page, Hawker, Miles, Percival, Saro, Short, Vickers.

France : Products by Aerocentre, Arsenal, Bloch, Breguet, Guerchais, Holste, Morane-Saulnier, S.N.C.A.N. (Nord), Sud-Est (S.E.), S.E.C.A.N., S.I.P.A., S.N.C.A.S.O.

Czechoslovakia : Products by Avia, Sokol, Zlin, Praga. I. G. B.

156. The Supermarine Spitfire Trainer Mk. VIII. Anon. *Aeroplane*, 1946, **71**, 632.—A cutaway drawing by J. H. Clark of this aeroplane shows the installation of the 1315 h.p. Rolls-Royce Merlin 66 engine. Cockpit layout details are also given. I. G. B.

157. Aircraft Industry Review. *Aeroplane*, 15.11.46, **71** (1851), Special supplement.—This supplement to " The Aeroplane " gives valuable information on current products of the British aircraft industry. Details are given under the following headings.

Civil Aircraft : Type, accommodation, power-plant, dimensions, weights and performances of the following aircraft :—Bristol, Type 167, Mk. I, Saro SR/45, Avro Lancastrian, Avro Tudor I and II, Avro York, Handley-Page Halton, Short Sandringham, Short Shetland, Short Solent.

Naval Aircraft : Blackburn Firebrand V, De Havilland Sea Hornet XX, Fairey Firefly IV and Spearfish I, Hawker Sea Fury X, Short Sturgeon I, Vickers-Armstrong Supermarine, Seafire 47, and Seafang 32.

Jet Propelled Aircraft : De Havilland Vampire I, Gloster Meteor IV, Vickers Supermarine E10/44, De Havilland DH 108.

Military Aircraft : Hawker Tempest VI, De Havilland Mosquito 34, Westland Welkin IIA, Bristol Brigand I.

Trainer Aircraft : Percival Prentice I, Fairey Firefly Trainer I, Vickers-Armstrong Supermarine Spitfire Trainer VIII, Reid and Sigrist Desford I.

Personal Aircraft : Auster Autocrat and Arrow, Miles Messenger, Percival Proctor V, Miles Gemini.

Feeder Transport : Airspeed Consul, Bristol Wayfarer, De Havilland Dove, Miles Aerovan and Marathon, Avro XIX, Vickers-Armstrongs Viking IB.

Heavy Military Aircraft : Avro Lincoln II, Handley Page Hastings.

Jet Engines : Armstrong Siddeley Mamba and Python, De Havilland Goblin II and Ghost, Rolls-Royce Derwent V and Nene, Bristol Theseus I, Metropolitan-Vickers F.2/4A.

Reciprocating Engines—Aircooled : Alvis Leonides, Armstrong Siddeley Cheetah 25, Blackburn Cirrus Major III & Minor II, Bristol Hercules and Centaurus 57, De Havilland Gipsy Major X, Major 51, and Gipsy Queen 71.

Reciprocating Engines Liquid-Cooled : Napier Sabre VII, Rolls Royce Merlin 620 and Griffon 74. I. G. B.

158. Leonides Air Tests. Anon. *Flight*, 1946, **50**, 491.—Alvis, Ltd., have just started small-scale production of the latest Leonides following successful completion of the full military type-test and more than 50 hours test flying with 2 units installed in an Airspeed Oxford. The Leonides is a 9-cyl radial, giving a max. output of 515 h.p. at 4000 ft and having an international rating of 425 h.p. at 9000 ft. Overall dia. is 42 in and max. power/weight ratio 1·44 lb/b.h.p. The weak-mixture fuel consumption is 0·49 pt/b.h.p./hr. I. G. B.

159. Principal Data of British Power Units. Anon. *Flight*, 1946, **50**, 567.—*Piston Engines :* Under the headings : Maker's Name and Engine type ; No. and Arrangement of Cylinders ; Cooling ; Bore × Stroke (in) ; Capacity, litres ; Reduction Gear Ratio ; Max. Power Rating (b.h.p., r.p.m., Boost lb/sq. in, ht (ft) ; Recommended Economical Cruising Power (b.h.p., r.p.m., Boost lb/sq. in, ht (ft)) ; Take-Off Power ; Fuel Consumption R.E.C.P. G.P.H. ; Dry Weight (lb) and Notes ; details are given of the engines produced by Alvis, Armstrong Siddeley, Blackburn, Bristol, De Havilland, Fedden, Monaco, Napier, Rolls-Royce.

Gas Turbine Power Units : Under the headings : Maker's Name and Engine Type ; Type of Compressor ; No. of Combustion Chambers ; Max. Power Rating (Sea Level Static) (Thrust lb, Shaft h.p., r.p.m.) ; Recommended Economical Cruising Power (R.E.C.P.) (Thrust lb, Shaft h.p. r.p.m., Speed (m.p.h.) and Ht.) ; Fuel Consumption (R.E.C.P.) G.P.H. ; Diam. and Length in ; Dry Weight lb ; and Notes ; details are given of the engines produced by Armstrong Siddeley, Bristol, de Havilland, Metropolitan-Vickers, and Rolls-Royce. I. G. B.

160. Engines at the Paris Show. Anon. *Flight*, 1946, **50**, 569.—A review is given of the products shown. Especially interesting is the diagrammatic section of the Rateau A.65 turbo-jet which has 4 low-pressure and 12 high-pressure stages of compression. The 9 combustion chambers are grouped round the compressor casing and are of the reverse-flow type feeding rearwards into the 2-stage turbine. A portion of the air from the low-pressure stages of compression is by-passed to the tail pipe at a point level with the cone behind the turbine. Here extra fuel can be injected to give after-burning. I. G. B.

161. Britain's Power Units. Anon. *Flight*, 1946, **50**, 567.—Cutaway sketches and photographs of the following engines are given :—*De Havilland :* Goblin II, Ghost and Gipsy Queen 71, and Gipsy Major 31.

Metrovick : F/3.

Rolls-Royce : Derwent, Griffon and Nene.

Armstrong Siddeley : Cheetah, Mamba, and Python.

Bristol : Centaurus and Theseus.

Alvis : Leonides.

Napier : Sabre.

Blackburn : Cirrus Minor, Series II, and Cirrus Major, Series III. I. G. B.

MISCELLANEOUS.

162. "Germany under Control" Exhibition. 1. Petroleum Production and Refineries in Germany. Anon. *Petroleum*, 1946, **9**, 228.—Diagrams, tables, and maps are given illustrating the products and monthly output from German oilfields and refineries (Oct. 1945–June 1946) in the British occupation zone. K. C. G. K.

163. Bolivia will Develop her Petroleum Industry to Advantage. Anon. *Ind. Min. (Argentina)*, 1946, **6** (60), 33–35.—Known reserves at Camiri are about 20 million brl. It has been decided to concentrate most new drilling in this area and to construct

a pipeline from Camiri to Cochabamba (about 250 miles) at a cost of 5 million dollars. Cochabamba being favourably located for water supply and as a distributing centre, it will become the home of a complete refinery, designed by Foster Wheeler Corp., and costing 7 million dollars, which will make from Bolivian crude all the petroleum products needed in the country. A. C.

164. Post-War Research Forges Ahead. Anon. *Chem. Ind.*, 1946, **49**, 259–267.—The achievements of the U.S. industrial chemical research during the past two years are recorded in seven articles by experts, who discuss and evaluate the developments from their particular aspect.

The branches of industry covered are those of inorganics, synthetic organics, coal-tar products, Naval stores, pharmaceuticals, plastic materials and polymers, and dyestuffs.

Another aspect of the chemical field is surveyed under the title "Chemical Specialities Open New Markets" (pp. 269–277). Precise definition of what is and what is not a chemical speciality is difficult. It is classified rather arbitrarily as "any standard chemical product which has been elaborated on in any way before sale." Outlines of recent trends and developments in this field are contributed by authorities, in their special spheres, in fourteen articles in which 160 new chemical specialities are quoted. The sections cover the following uses—household disinfectants, household cleaners, polishes, air deodorants, insecticides, rubber chemicals, leather chemicals, industrial adhesives, industrial cleaners, industrial disinfectants, agricultural chemicals, pulp and paper chemicals, textile chemicals, and protective organic coatings. The foregoing two aspects of post-war research includes some 400 new chemicals and chemical specialities. W. H. C.

165. Liquid Methane as a Motor Fuel. 3 Fuel Performance. R. M. Bridgwater. *Petroleum*, 1946, **9**, 227.—An outline of various road trials carried out with liquid methane as fuel between 1939 and 1944 is given, and difficulties of tanking with liquid methane are mentioned. The thermal capacity of the filling pipe and connections must be kept as low as possible. The vehicle tank should not be allowed to get completely empty, since otherwise liquid is evaporated in cooling it down from air temperature. The design of storage tanks is also discussed. As regards safety, although methane is much more volatile than petrol the explosive mixture limits in air are quite different from petrol (5·3–14·9% methane, 1·5–5·5% petrol) and methane cannot be ignited by a heat source below 700° C while petrol vapour may ignite at 200–300° C. The methane flame is readily blown out and a considerable fire can be extinguished by carbon dioxide. K. C. G. K.

166. Mixed Metal Organic Salts. Anon. *Paint Tech.*, 1946, **11**, 286.—B.P. No. 549,332, granted to Nuodex Products Incorp., New Jersey, U.S.A., relates to the manufacture of complex salts of organic acids, *e.g.*, naphthenates, resinates, linoleates, benzoates, etc., comprising a water-soluble constituent containing a metallic radical from the group, sodium, potassium, lithium, and ammonium, and a water-insoluble constituent containing a metal from the group, cobalt, manganese, lead, zinc, iron or copper. Such materials are soluble in paint and varnish vehicles, and are useful as driers and wetting and dispersing agents, etc., for paint varnish and lacquer manufacture. A colour-intensifying agent is also specified.

The components, quantities, and conditions of preparing such materials are given for the following:—Lead sodium naphthenate, which in mineral spirits is soluble in raw linseed oil, varnishes, etc., and remains clear for long periods. Zinc potassium naphthenate has wetting and dispersing properties when used in paints and enamels. Calcium sodium naphthenate is a satisfactory dispersing agent for pigments in similar manufactures. Zinc sodium naphthenate is stated to be more satisfactory than either napthenate alone for softening rubber compositions. A complex material made from naphthenic acid, ammonium acetate, lithium carbonate, barium hydroxide, with or without hydrogen peroxide, when treated with "ink mineral oil" as described, is stated to save 75% of the expensive blue toner used in ink manufacture. W. H. C.

167. Agents, Basic Causes, Control and Prevention of Corrosion. F. A. Prange. *Oil Gas J.*, 7.9.46, **45** (18), 90.—The elements and compounds that bring about corrosion

of metal surfaces are described. The two main types of corrosion that occur are: (1) That due to direct chemical action, *e.g.*, scaling of steel at elevated temperatures, or the action of acids on pure metals; and (2) more importantly, that due to electrolytic action, *e.g.*, the action of acids on commercial metals, rusting, bimetallic corrosion, and pitting of metals.

Corrosion by pitting is particularly serious and may occur in two ways: (*a*) through high-velocity flow of liquids (cavitation, termed corrosion-erosion), is described; (*b*) that due to electrolytic action, which is discussed from the aspects of four kinds of cells, (1) the simple galvanic cell, (2) the metal ion cell, (3) the oxygen concentration cell, and (4) the stray-current cell.

The principles of the cells 1, 2, and 3 are shown in diagrams indicating the reactions involved. The effects of temperature and of concentration are outlined, and the effect of materials that accelerate corrosion, *e.g.*, the action of sodium chloride and the use of materials which act as inhibitors to corrosion, are discussed. This paper will be concluded in a later issue of the journal. W. H. C.

168. Application of Dust-Laying Oil to Fabrics. C. H. Bailey, A. S. Weatherburn, and G. F. R. Rose. *Canad. Chem. and Process Industries*, Sept. 1946, **30** (9), 43.—During bed-making a considerable amount of bacteria containing dust is disseminated into the air and it is believed may cause infection of nearby patients in hospitals. An effective means of preventing such contamination of the air has been found; it consists of impregnating the bed-clothes with 3–7% of liquid paraffin oil, and affords a 95% reduction of the number of bacteria scattered into the air. Experiments were conducted on wool and cotton treated with emulsions by the method developed by Harwood, Powney, and Edwards. For wool, a dilute oil-in-water emulsion is used which is stabilized with a cation-active emulsifying agent; this imparts a positive charge to the oil drops of the emulsion. Wet wool has a negative charge, so that when contacted with the emulsion the oil drops are deposited by electrostatic attraction. The emulsifier used is Triton-K-60, and the oil is a technical white oil. Cotton oiling can be accomplished by the mutual coagulation of two oppositely charged oil-in-water emulsions. The negatively charged emulsion is made by using Igepon T; the positively charged emulsion is similar to the one described. Two types of dual emulsions are described, as to oil content, and ratio of emulsifier used, both types being adjusted so that each of the emulsions would contain equivalent amounts of positive and negative charges. The chemistry of the process is discussed, the tests carried out on the emulsions, and their composition are given. The practical application of the process in pilot and commercial plant trials are described. The degree of oiling can be accurately controlled, and the fabrics can be treated after laundering with the normal laundry equipment. The costs of materials, exclusive of normal laundering costs, for wool and cotton is approximately 60 cents and 65 cents per 100 lb respectively. W. H. C.

BOOKS RECEIVED.

An Introduction to the Principles of Physical Chemistry. O. Maass and E. W. R. Steacie. Pp. 395 + ix. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd.: 2nd edn. 1939, reprinted 1946.

In this revised edition new chapters have been added on atomic structure, the phase rule, and colloidal systems. Other chapters have been rewritten or extended to bring the matter up-to-date.

Manual on Hot-Mix Asphaltic Concrete. Pp. 112. New York: The Asphalt Institute, 1945.

This manual contains two specifications for asphaltic concrete—"dense graded aggregate "type" and "graded aggregate type"—the fundamental difference being in the manner of specifying aggregate gradation and the relative emphasis placed on density of the compacted mixture. Sections on recommended thickness requirements and on inspection are included.

Journal of The National Lubricating Oil and Grease Federation. Vol. I, No. 1, Oct. 1946.

This new quarterly publication is mainly devoted to the affairs of the Federation and matters concerning the lubricating oil trade. It also includes an article on "Post-War Oil Supplies," by Harold Moore.

British Lubricating Oil and Grease Research Association, Publications and Information Panel Journal. Vol. I, No. 1, Sept. 1946.

This publication is the first of a series to be published by the recently formed British Lubricating Oil and Grease Research Association, and will appear quarterly. This number contains articles on "Anti-Wear and Anti-Corrosion Additives," by R. J. S. Perry, and on "Lubricants and the Nation," by J. E. Southcombe, together with abstracts of literature on lubricants and lubrication.

Recommendations for Open-Textured Asphalt Carpets. D.S.I.R. Road Research Bulletin No. 5. Pp. 6 + iii. London: H.M. Stationery Office, 1946. 3*d*.

First published in 1941 as Wartime Road Note No. 3, only minor alterations have been made to the original text, which relates to carpets containing asphaltic bitumen binders.

Asphalts and Allied Substances. Herbert Abraham. 2 Vols. 5th Edn. New York: D. Van Nostrand Co., 1945. Pp. 2142 + xviii + viii.

This fifth edition of Herbert Abraham's well-known book has been revised and brought up-to-date in respect of technological developments, methods of testing, bibliography, and references. The bibliography embraces more than 1300 treatises and the references total over 20,000, including about 12,000 U.S. and other patents. Indexes of "Specifications," "Names" and "Patents" are useful additions.

Important Facts About Texas Oil and Gas. Dallas, Texas: The Texas Mid-Continent Oil & Gas Association, 1946. Pp. 43.

A complete and comprehensive compilation of information on the petroleum and natural gas industry of Texas.

The Centenary of the Technical University of Lwow, 1844–1944. 1946. Pp. 103.

A historical account of the work of the Technical University of Lwow, including a chapter on the part played by Graduates of the University in the petroleum and chemical industries.

Reports on Fuel Economy since 1939. London: World Power Conference, 1946.

Further reports in series prepared for the Fuel Economy Conference at the Hague, Sept. 2–10, 1947, are:

British Report. Pp. 52. 1*s*. 6*d*. Covers the history of the Ministry of Fuel & Power's Fuel Efficiency Campaign during the war years, and includes a 6-page bibliography.
Swedish Report. Pp. 20. 1*s*. Includes a section on liquid and gaseous fuels.
Danish Report. Pp. 6. 6*d*.
Netherlands Report. Pp. 5. 6*d*.

A Classified List of Industrialists' Reports on Germany.

The 973 reports by the teams of British and Allied experts who have visited Germany are listed under subject headings. The list includes all reports issued up to July 27, 1946, and covers 510 C.I.O.S. (Combined Intelligence Objectives Sub-Committee) reports, 347 B.I.O.S. (British Intelligence Objectives Sub-Committee), 108 F.I.A.T. (Field Information Agency, Technical), and 8 J.I.O.A. (Joint Intelligence Objectives Agency).

Petroleum Facilities of Germany. Prepared by the Enemy Oil Committee for the Fuels and Lubricants Division, Office of the Quartermaster General. March 1945. Pp. 372.

This report describes briefly all of the significant aspects of the petroleum economy of Germany and of the more important petroleum installations in that country.

The Dispersal of Fog from Airfield Runways. E. C. Walker and D. A. Fox. 1946. Pp. 321.

A record of the work of the Petroleum Warfare Department in relation to fog dispersal.

History of Development of Hades and Rapex Burners. W. T. Moore. 1945. Pp. 31 + diagrams and charts.

An account of the development of the Hades and Rapex Burners in connexion with fog dispersal investigations.

Additive Engine Oils. Los Angeles, Cal.: Petroleum Educational Institute, 1945. Pp. 150. $3.75.

This work is an "effort to contribute further to the elementary material already published on the subject of petroleum and its products" by means of simple diagrams and explanatory text. It is particularly related to motor lubricants and lubrication "for the benefit of maintenance personnel at service stations, car and truck dealers, repair shops, and flat operators."

The Future of Industrial Research. New York: Standard Oil Development Co., 1945. Pp. 173 + viii.

In October 1944 the Standard Oil Development Co. made its Silver Anniversary a Forum on the Future of Industrial Research, and this book presents the papers and discussion. For Part I the theme is "What should be the guiding principles and objectives for the commercial programmes of industrial research and development organizations?"; for Part II, "How can small business serve itself and be served by industrial research and development?"; and for Part III, "What place should industrial research and development organizations allocate to future work directly primarily toward national security?"

Oil in Your Future. Oklahoma City: Interstate Oil Compact Commission, 1946. Pp. 28.

This booklet was prepared by the Interstate Air Compact Commission in order that "the public may become better informed about and more sympathetic to the perplexing problems encountered in the conservation of oil and gas."

New British Standards. The following have recently been issued by the British Standards Institution:

B.S. 1321: 1946. Synthetic-Resin Bonded-Paper Sheet (Thermosetting) for use in the Building Industry. 2*s.* post free.

B.S. 1328: 1946. Methods of Sampling Water used in Steam Generation. 3*s.* 6*d.* post free.

B.S. 1333: 1946. Acid Resisting Silicon Iron Pipes and Pipe Fittings (Elbows, bends, tees, crosses). 2*s.* post free.

P.D. 539. Recommendations for Phosphate Coatings as a Basis for Painting Steel. 1*s.* post free.

TECHNICAL MISSIONS TO GERMANY.

The following reports have been received in addition to those listed in the *Journal* 1945, on pp. 226A–230A, 316A–318A, 408A–410A:

B.I.O.S. Reports.

42.* Reports on W.I.F.O. Oil Storage Depots located at Eickeloh, Ruthen, and Nieuberg, with particular reference to drum and can filling. Pp. 14.

123. Visits to Miscellaneous Aeronautical Establishments in the British Zone. Pp. 15.

537 (Appendix). Production Control in the Heinkel Aircraft Organization. Pp. 51.

538. Report on German Patent Records. Pp. 16.

620. The German Motor-cycle Industry. Pp. 179.

663. Manufacture of Synthetic Resins by I.G. Farbenindustrie, Ludwigshafen. Pp. 5.

664. I.G. Farbenindustrie, Leverhausen: Salicyclic Acid, Sodium Salicylate, Synthetic Phenol. Pp. 10.

666.* I.G. Farbenindustrie, Uerdingen: Manufacture of Phthalic Anhydride, Benzoic Acid, etc. Pp. 7.

667. I.G. Farbenindustrie, Mainkur. Pp. 5.
686. Ethylene Oxide by Direct Oxidation of Ethylene at Zweckel, I.G. Farbenindustrie. Pp. 4.
697.* Fire Protection of Oil Installations in Germany. Pp. 44.
704.* Mechanical Foam Liquid and Equipment. Pp. 13.
709. Production of Tetranitromethane and Nitroform at I.G. Farbenindustrie, Hochst-am-Main. Pp. 13.
710. Manufacture of Biolase (starch-hydrolysing enzyme) at Kalle & Co. (I.G. Farben. A.G.), Wiesbaden, Biebrich. Pp. 5.
719. Interview with Prof. Otto Bayer (formerly Head of Scientific Laboratories, I.G. Farben., Leverkusen). Pp. 6.
732.* Lüneburger Wachswerke A.G., Lüneberg: Waxes. Pp. 15.
736. Chemical Laboratory Instrumentation in Germany. Pp. 28.
740. C. F. Boehringer und Soehne, Mannheim-Waldhof: Commercial Organic Solvent Production. Pp. 7.
741. Zellitafffabrik A.G., Mannheim. Pp. 7.
742. Preparation and Polymerization of Vinyl Ethers and Preparation of Acetaldehyde from Methyl Vinyl Ether at I.G. Farbenindustrie, Ludwigshafen. Pp. 10.
743. Manufacture of Cyclohexanol, Cyclohexanone, Cycleketone Resins at I.G., Ludwigshafen. Pp. 11.
748.* Manufacture of Fatty Acids by Oxidation of Paraffins; Hydrogenation of the Fatty Acids at I.G., Ludwigshafen-Oppau. Pp. 15.
749. Pilot Plant at I.G. Höchst on the Manufacture of Diketene from Acetic Acid. Pp. 3.
750. Manufacture of Monomeric Styrene at I.G. Ludwigshafen. Pp. 9.
751. Pilot Plant Manufacture of Vinylacetylene at I.G. Höchst. Pp. 4.
757. Manufacture of Ethylene Cyanhydrin at I.G. Ludwigshafen. Pp. 3.
764. Production of Aluminium Compounds in Germany. Pp. 38.
766. Manufacture of Pharmaceuticals and Fine Chemicals in the U.S. and French Zones of Germany. Pp. 329.
768. The German Automobile Industry. Pp. 74.
805.* Aspects of the Synthetic Fatty Acid and Synthetic Fat Industry in Germany. Pp. 99.
835.* Benzole Refinery, Amalia, Bochum. Pp. 2.
837. Design, Construction, and Production of High Speed Centrifuges. Pp. 14.
877.* Oxidation of Hydrocarbons to Ethylene and of Methane to Acetylene, with Conversion of Acetylene to Acetone, I.G., Oppau. Pp. 7.

F.I.A.T. Reports.

92. German Processing of Fats, Oils, and Oilseeds. Pp. 125.
299.* Supplemental Report on the Ruhrol Hydrogenation Plant, Welheim, Ruhr. Pp. 5.
499. Production of Wood Sugar in Germany and Its Conversion to Yeast and Alcohol. Pp. 117.
525. Poppet Valves for Automotive and Aircraft Engines. Pp. 19.
564. Boilers, Forced Draft Blowers, Steam Piping and Evaporators Used in the German Mercantile Marine. Pp. 25.
581. Beier Infinitely Variable Speed Friction Drive Transmission. Pp. 18.
600. Air Filters and Oil Filters for Engines. Pp. 12.
713. Cellulose Acetate Manufacture at Schering A.G., Berlin. Pp. 13.
721. Agfacolour Negative-positive Method for Professional Motion Pictures. Pp. 32.
873. Self-ignition of Mixtures of Hydrocarbons and Air Subjected to Very Sudden Adiabatic Compression. Pp. 10.
857. Production of Acetic Acid at Burghausen and Knapsack; Concurrent Production of Acetic Acid and Acetic Anhydride at Knapsack. Pp. 24.

J.I.O.A. Reports.

34. German Chemical Fire Extinguishers. Pp. 108.
64. Instructions for Preparation of the Dyestuffs Filterblaugrun Spietloslich and Filterblaugrun Wasserloslich. Pp. 6.
66. Glossary of Some German Names for Chemical Products Used in the Paint, Varnish and Lacquer Industry. Pp. 13.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	46 A
Geophysics and Geochemical Prospecting	49 A
Drilling	54 A
Production	56 A
Oilfield Development ...	62 A
TRANSPORT AND STORAGE ...	64 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	65 A
Distillation	66 A
Absorption and Adsorption ...	66 A
Cracking	67 A
Polymerization	68 A
Alkylation	68 A
Chemical and Physical Refining	69 A
PRODUCTS.	
Chemistry and Physics ...	69 A
Analysis and Testing ...	72 A
Gas	72 A
Engine Fuels	73 A
Lubricants	73 A
Derived Chemical Products ...	74 A
Miscellaneous Products ...	74 A
ENGINES AND AUTOMOTIVE EQUIPMENT	75 A
MISCELLANEOUS	79 A

AUTHOR INDEX.

The numbers refer to the Abstract Number.

Alcock, E. D., 192
Allen, R. C., 289
Ames, R. S., 296
Anderson, H. H., 256
Anderson, J. F., 209
Athey, N. D., 291

Beck, J. V., 222
Bell, J. S., 178
Bents, E. J. H., 308
Beuther, H., 273
Blum, V. J., 186
Boisblanc de D. R., 288
Bossler, R. B., 223
Brod, I. O., 169, 171
Brooner, G. M., 275
Buckley, S. E., 220

Campbell, O. E., 200
Chovin, P., 276
Cicalese, J. J., 266
Clinedinst, W. O., 214
Coggeshall, N. D., 287
Conn, M. W., 278
Cooke, S. R. B., 182
Cowles, L. G., 202
Cox, C. E., 313
Crawford, C. C., 293

D'Arcy, N. A., 242
Davies, J. A., 266
Day, A. H., 251
Deegan, C. J., 240
DeHettre, J. P., 215
Dix, C. H., 196
Dodd, J. D., 176
Dresbach, C. H., 208
Dugan, A. F., 207

Farmer, H. O., 314
Ferretti, P., 307
Field, H. W., 274
Fogel, M. C., 273
Foster, A. L., 267
French, F. A., 277

Gaby, P. P., 195
Gandolfi, R., 321
Gemant, A., 279
Glasgow, A. R., 283
Glasgow, Jr., A. R., 286
Gould, D. W., 274
Grant, B. F., 223
Grilly, E. R., 280
Gross, R. J., 255
Gundy van, C. B., 174

Hardy, J. K., 298
Harrington, P. J., 266
Harta, H. W., 262
Hassebrock, W. E., 216
Hastings, W. K., 201
Hetland, C. A., 305
Hill, T. L., 281
Hirsch, J. H., 272
Horton, C. W., 187
Horvitz, L., 184
Houghland, G. S., 266
Hughes, R. V., 231
Hutchinson, A. J., 266

Jenkins, H. D., 243
Jensen, H., 198, 199
Johnston, H. L., 280
Jones, E. N., 260
Jones, J. P., 229
Jones, P. J., 232
Justice, W. H., 260

Kaveler, H. H., 217
Kelly, C. I., 292
Kersteu, G. V., 218
Klaus, K., 204
Korobkov, I. A., 180
Kramers, H. A., 278

Landen, E. W., 309
Lawton, H., 225
Lay, R. L., 189
Lewis, J. O., 221

McClintock, F. A., 297
McGee, D. A., 243
Maimin, Z. L., 180
Mair, B. J., 284
Marshall, R. W., 212
Minervini, C., 290
Morgan, F., 236
Moureau, H., 276
Mullane, J. J., 230
Murphy, E. T., 286
Muskat, M., 236

Nelson, W. L., 259, 263, 264, 265
Nielsen, R. F., 224
Nowels, K. B., 233

Offutt, W. C., 272, 273
Ostergaard, P., 272, 273
Owner, F. M., 301, 302

Page, H. W., 320
Parker, I. M., 257
Peters, J. W., 207
Pfister, R. J., 234
Phipps, H. K., 258
Pipparelli, E., 290
Pitzer, K. S., 285
Plummer, F. B., 237

Ragatz, E. G., 268
Ragland, D., 211
Rasmussen, R. S., 277
Rich, H., 229
Richardson, J. A., 268
Ricker, N., 188
Rivoal, G., 276
Roberti, G., 290
Robinson, W. B., 191
Rogers, D., 228
Rossini, F. D., 283, 284, 285, 286
Russell, E. G., 236

Schade, H. A., 311
Schweitzer, P. H., 310
Seeley, S. W., 303
Semmola, E., 290
Semon, L., 295
Sharp, R. C., 212
Shchelkachev, V. N., 183
Shelby, Jr., T. H., 178
Skinner, J. W., 179
Sloss, L. L., 182
Squires, F., 235
Streiff, A. J., 283
Stulken, E. J., 190
Sutton, A. N., 250

Taylor, W. J., 280, 285
Teplitz, A. J., 216
Termini, D. J., 284
Thomas, B., 219
Thompson, L. S., 181
Thornton, O. F., 230
Tordi, L., 282
Travers, W. J., 226
Trimble, H. M., 288
Tripp, R. M., 193, 194

Varr, A. F., 230
Vialov, O. S., 170
Vietti, W. V., 230

Wagman, D. D., 285
Walling, I. W., 237
Walsh, T. J., 266
Ward, A. F. H., 282
Weatherby, B. B., 206
Weber, G., 227
Wendtlandt, E. A., 178
West, S. S., 185
Whistler, A. M., 269
Williams, M. G., 285
Williams, N., 261
Willingham, C. B., 283, 284, 286
Willis, Bailey, 175
Wilson, W. Ker, 312

Yuster, S. T., 224

Oilfield Exploration and Exploitation.

Geology.

169. Classification of Oil and Gas Accumulations According to the Proportions of Fluids in Natural Reservoirs. I. O. Brod. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **53**, 55 (in English).—From a study of the proportions of gas and oil in natural reservoirs, four classes of accumulations are distinguished and tabulated, together with the characteristics of the natural reservoirs in which they occur and the behaviour of the reservoir fluids during working. The classes discussed are (*a*) pure gas accumulations, (*b*) oil pools with gas caps, (*c*) oil pools rich in gas, (*d*) oil accumulations rich in gas. G. H. B.

170. On the Presence of Marine Fauna in a Gypsum Band. O. S. Vialov. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **52**, 333–334 (in English).—Observations made in test pits at the Maili-Sai petroleum and ozokerite deposits show that the typical fauna, genus *Fatina* of the middle (TrK_3) horizon of the Turkestanian stage of the Palæogene formation of Ferghana is associated with pyrites and not with gypsum, as previously found in outcropping TrK_3 horizons. A similar specimen of pyritized genus *Fatina* has also been found in a test pit in the Shor-su ozokerite deposit of South Ferghana, again with gypsum absent. It is concluded that gypsum is secondary in this horizon, and a process leading to its formation is suggested. This conclusion accounts for the ecological incongruence of the apparent joint occurrence of fauna of genus *Fatina* and gypsum and indicate that the occurrence of gypsum in sediments devoid of fauna may not be regarded as evidence of marine origin. G. H. B.

171. Territorial Units in Petroleum Geology. I. O. Brod. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **52**, 433.—Previous geographical and geological divisions of the surface of the earth with respect to the occurrence of petroleum are reviewed and extended. Three geographical and three geological territorial units are proposed, and further subdivisions of these units described with examples. 40 literature references. G. H. B.

172. Continental Shelf Stirs Interest in Submarine Drilling. Anon. *World Petrol.*, March 1946, **17** (3), 36.—Favourable land areas for oil development are estimated to amount to 6,000,000 sq. ml., and in U.S.A. the figure is about 1,000,000 sq. ml. Petroleum has already been discovered in submerged areas along the coasts of Louisiana and Texas, in the Caspian, and in Lake Maracaibo.

Off U.S.A. submerged portions of the continent amount to 750,000 sq. ml. out to depths of 600 ft of water. The width of the belt ranges 20–250 ml., 149,000 sq. ml. of shelf lie in the Gulf of Mexico. Many maintain that it is not practicable to drill in water over 100 ft deep. However, fairly extensive shelf areas possess petroleum possibilities. Salt plugs may occur off the Gulf Coast in an area which may have production from Miocene and Pliocene beds. Gravimetric, seismic, and magnetic surveys are possible in some submerged areas. G. D. H.

173. Navy has Ambitious Plans for Alaskan Oil Development. Anon. *World Petrol.*, Aug. 1946, **17** (9), 50.—Exploration has so far been restricted to the eastern third of the No. 4 Petroleum Reserve of the U.S. Navy. Geological and geophysical work has been carried out. A structure at Umiat Mountain is being tested, and a well which has reached 2000 ft has passed tight but oil-saturated beds. The structure has an oil seep, and according to MacNaughton a test to 6000 ft should be adequate since he knows of no structure with seeps where the production is over 1 ml. deep.

A preliminary pipeline survey has been made. Estimates indicate that a reserve of 400–500 million brl and a potential of 100,000 brl/day must be found to warrant development. Some indications of development costs are given, the estimated total ranging from $50,000,000 to $95,000,000. G. D. H.

174. Faulting in East Part of Grand Canyon of Arizona. C. E. van Gundy. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1899.—The characteristics of several faults and their associated folds in the Grand Canyon district of Arizona are shown in the excellent rock exposures of the deeply dissected canyons of this region. Two of the major local faults are shown to have been active in the pre-Cambrian and again in post-Palæozoic time. Monoclines, anticlines, and synclines appear to have been formed by the combination of normal faulting at depth and the regional dip. E. N. T.

175. Normal Fault Structures and Others. Bailey Willis. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1875.—This paper calls attention to the very general development of shearing as a form of deformation of rock masses in the earth's crust as a result of either vertical or horizontal compression, either alone or in combination with folding. Normal faulting is depicted as a mountain-making effect due to uplift against gravity. The structure of the Colorado plateau is taken as the type example.

Basin-range faulting is considered as closely similar. The mechanism of normal faulting is analysed and it is shown that one result is lateral expansion, which produces compression where tension is usually assumed. Normal-fault provinces are described. E. N. T.

176. North Florida Province is Geologically Attractive. J. D. Dodd. *World Petrol.*, March 1946, **17** (3), 44.—The North Florida province includes the area north of the Central Platform, and the adjacent parts of Georgia and Alabama. Up to 1941 80 wells had been drilled in this area, but only four were considered to be significant. Geophysical work reached a peak of 1397 crew-weeks in 1945, and about five-sevenths of the area is under lease. 20–30 wildcats are projected for 1946.

Rocks from Eocene to Recent are exposed, the Ocala being the oldest formation seen. The Selma, Eutaw and Tuscaloosa underlie the Tertiary. The Selma is chalk, but might appear as a reef and become sandy. The Eutaw consists of shales and sands, and produces elsewhere. Gas shows have been reported. The Tuscaloosa is thought to be of shallow water origin. It is equivalent to the Woodbine of East Texas, and consists of coarse sands and gravels. It may lie 3000–4000 ft deep. A well has reported an oil show. The Comanchean consists of sands and shales. Some wells have entered the underlying Jurassic, Triassic, and Palæozoic. The Nassau County well found a black shale with an oily odour.

The Coastal Ridge is parallel to the Georgia coastline. Wells on this ridge find granite above 4500 ft. There is a thin Tuscaloosa section above the granite, but to the west the Tuscaloosa is thick with Comanchean, Jurassic, Triassic, and Palæozoic below. The Georgia Basin lies between the Coastal Ridge and the Appalachian Root. It contains a thick marine section. The Marianna–Chipley Uplift is not fully defined, but may be a continuation of the Wiggins Anticline of Mississippi. The section should be ample with good sand conditions. The Ocala Uplift seems merely to be the western part of the Central Platform shown by geophysical and other data. North of the platform the sediments are largely clastics. The strike is N.E.–S.W., parallel to the Appalachians; to the south the strike is N.W.–S.E. and the sediments are nearly all calcareous. In places they may not be very thick. South Florida is dominated by the Okeechobee syncline and the Antillean Arch.

Lower Cretaceous and Palæozoic beds must pinch out on both sides of the Georgia Basin. The Eutaw sands may pinch out on the northwest flank of the Central Platform. They are good reservoirs associated with marine beds. The Tuscaloosa pinches out on the northwest flank of the Central Platform.

The Sunniland field appears to be on a large fold with 50–100 ft of closure in the producing limestone. There may be fault traps.

Sunniland was found on re-interpreting gravity data. The reflection seismograph has not been very successful yet due to many difficulties. The basement can be detected by refraction, and the top of the Selma mapped. Magnetic surveys have been used to detect basement highs.

Prices of leases have risen from 5 cents an acre in the late thirties to $7–10 an acre for small desirable tracts. G. D. H.

177. More "Strat" Traps in Montana? Anon. *Oil Gas J.*, 22.6.46, **45** (7), 157.—The Cut Bank, Kevin, and Border stratigraphic traps on the Sweetgrass Arch have produced together about 10,000,000 brl of oil. In October 1945, a new area 5 ml. north-east of Cut

Bank was opened. It obtains oil from the Madison or Madison–Ellis contact. 2¼ ml. to the south of this discovery a small pumper 90 ft down in the Madison was converted into a well flowing 200 brl/day after acidization. Similar treatment of other small producers in this general area was equally beneficial.

Kevin produces mainly from the Ellis–Madison contact in a limestone porosity trap; Cut Bank produces from a sand porosity trap on the flank of the Kevin dome, some distance from the Kevin field. Border produces from what may be a sand porosity trap. The three fields seem to be related with regard to oil characteristics and waters, and so may have had a common origin. G. D. H.

178. Hawkins Field, Wood County, Texas. E. A. Wendtlandt, T. H. Shelby, Jr., and J. S. Bell. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1830.—The Hawkins oilfield occurs on a large north-eastward trending faulted anticline situated near the north-central part of the East Texas geosynclinal basin. A pronounced gravity minimum shows that the field is probably underlain by a deep-seated salt mass.

The field was discovered in December 1940 and by September 1945, when regulations of the Petroleum Administration for War were rescinded, 415 oil wells had been completed. These had produced 43,134,613 brl of oil from the Woodbine formation at an average depth of 4,850 ft.

The crude is an asphaltic mixed-base oil, and the ultimate recovery is estimated as just under 450 million brl. E. N. T.

179. Correlation of Permian of West Texas and S.E. New Mexico. J. W. Skinner. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1857.—This paper presents new evidence regarding the age of the San Andres formation, and correlates it with the Cherry Canyon formation of the Delaware Mountains, the upper part of the Word formation of the Glass Mountains, and the "Blaine of Texas" of the eastern shelf. The Glorieta formation of New Mexico is correlated with the upper part of the Cutoff member of the Bone Spring formation of the Delaware Mountains, the uppermost beds of the Leonard formation of the Glass Mountains, and the "Holt pay" of north-central Ector County, Texas. The San Angelo formation is correlated with the upper part of the Yeso formation of New Mexico, with beds in the upper part of the Leonard formation of the Glass Mountains, and with the middle and lower members of the Cutoff section of the Bone Spring formation. The Grayburg formation of the subsurface is shown to be equivalent to the lower part of the Queen formation of the Guadalupe Mountains. E. N. T.

180. New Data on the Age of the Lower Maikop Beds of the Crimea and Caucasus. Z. L. Maimin and I. A. Korobkov. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **53**, 59 (in English).—The discovery for the first time of a rather abundant fauna of molluscs in the Maikop beds of the Crimea on the Mokry Indol river has allowed these beds to be related to the Lower Oligocene deposits of North Germany, the Khadum beds of the Caucasus and the Kharkov stage of the Ukraine. All four deposits are regarded as synchronous and reasons for the differences between them with respect to sedimentary character and fauna are advanced. The Maikop deposits are regionally oil-bearing throughout the Caucasus and the Kerch Peninsula. G. H. B.

181. An Appraisal of Iranian Oil. L. S. Thompson. *Oil Gas J.*, 29.6.46, **45** (8), 64.—Upon a basement complex of schists, granites, gneisses, etc., presumably of pre-Cambrian age, many thousands of feet of sediments have been deposited in Iran. They are mostly marine, and every system from Cambrian to Recent is represented in one or other part of Iran. Big breaks in deposition occurred at the end of the Cambrian, at the end of the Palæozoic, and at the end of the Cretaceous. There were other more localized unconformities. The movements at the end of the Cretaceous separated an Aralo–Caspian basin from a Paris–Mediterranean basin.

In the Masjid-i-Sulaiman, Haft Kel, Agha Jari, Gach Saran, Naft Khaneh, and Naft-i-Shah fields, together with Kirkuk in Iraq, there is geological similarity. The Asmari reservoir rock is often shattered in the producing areas, and may be 1000 ft thick. The Lower Farso provides a cap-rock. The structures are broad, with steep flanks. The Eocene is said to have oil at Masjid-i-Sulaiman, but it has not been exploited commercially.

The reserves of the developed areas may be 8,000,000,000 brl. The same belt has other favourable looking but untested structures. On the southwest side of the Persian Gulf the Upper Cretaceous is productive, but the few Cretaceous tests in Iran have been unsuccessful.

Between Qum and Sultanabad there are favourable structures. Only one authenticated seepage is known from the Central Depression, and two wells were drilled near it in the early 1930's. In the north the Caspian plain has oil possibilities. Pliocene beds have been noted resting on Cretaceous, and elsewhere Eocene beds lie unconformably on Cretaceous. In many places in Northern Iran the black Devonian and Carboniferous limestones have a petroliferous odour when freshly fractured, but they are very tight. Farther east in Central Asia the Jurassic is productive. There are numerous large faulted anticlines, but seepages are absent. G. D. H.

Geophysics and Geochemical Prospecting.

182. Spectrochemical Sample Logging of Limestones. L. L. Sloss and S. R. B. Cooke. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1888.—A method is presented of utilizing quantitative spectrographic analysis for the detailed differentiation and correlation of thick sequences of carbonate rocks which cannot be satisfactorily differentiated by visual or heavy-residue examinations.

The spectrograph used in the investigations was a five-foot Wadsworth type grating spectrograph with an original first-order concave grating. The spectrograph was designed to cover the spectrum from 2,000 to 10,000 Å.

Either field or core samples can be examined by this technique if chosen at suitable stratigraphic intervals. Samples have to be weighed to the nearest 0·01 mg within 0·2 mg of 5 mg. Standard samples used in obtaining calibration curves weigh 5 mg plus or minus 0·01mg. Slavin's total-energy method was used in evaluating the spectrographic analysis.

It was found that Ca, Mg, Sr, Ba, Al, Ti, Fe, and Si, were present in all samples, and Mn and V in some. For practical reasons, S, P, Na, and K, undoubtedly present, could not be determined. The most useful elements appear to be Mg, Fe, Al, and Sr When analyses of both surface samples and well cuttings are plotted against stratigraphic interval or well depth, the curves may be interpreted in terms of stratigraphic correlation and differentiation.

Standardization of the method is simple and the results are not dependent on the personal equation. Apart from initial expenditure for equipment, costs and time-consumption should be less than those required for foraminiferal and insoluble-residue analysis. E. N. T.

183. Some Applications of the Theory of Flow in Compressible Water- and Oil-Bearing Strata. V. N. Shchelkachev. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **52**, 395 (in English).—Equations of motion of a compressible fluid in a compressible porous medium, obtained by Shchelkachev in a previous note on the theory of flow in compressible water- and oil-bearing strata, are applied to observations made during a study of transient oil-well interference between two wells 200 metres apart in the XXII stratum of the October (New Grozny) district, Grozneft.

The increase in pressure at the head of the inoperative well (which was completely flooded with water) is measured, starting from the time that the second well, producing 300 tons per day, is stopped. The results of four sets of such observations are in close agreement with the calculated curve for pressure increase versus time, using the author's formula. G. H. B.

184. Recent Developments in Geochemical Prospecting for Petroleum. L. Horvitz. *Geophys.*, 1945, **10** (4), 487.—A number of surveys completed during the past two years indicate that the geochemical prospecting technique can be applied successfully only when an area is explored which is sufficiently large to enable ready distinction of the anomaly from the background.

Geochemical anomalies found by reconnaissance sampling have been proved to be associated with structure by the reflection seismograph. These confirmations indicate that the two methods can be used to supplement one another; one to detect the

possible presence of a petroleum accumulation and the other to determine the probable depth of the accumulation.

The results of a reconnaissance geochemical survey over the Heidelberg Area of Jasper County, Mississippi, are presented. E. I. R.

185. Relative Abundance of the Carbon Isotopes in Petroleum. S. S. West. *Geophys.*, 1945, **10** (3), 406.—The relative abundance of the isotopes of carbon has been measured in samples of oil and gas from 32 wells in the Silica and Ellinwood Fields of Barton and Rice Counties, Kansas, and 3 wells in Oklahoma, Texas, and Wyoming, as well as in surface vegetation, hydrocarbons from well cuttings, and carbon dioxide desorbed from soil. For the samples from Silica and Ellinwood Fields, $C^{12}/C^{13} = 94{\cdot}1 \pm 0{\cdot}4$. Relative abundance appears to be independent of the source of petroleum, but is about 1·6% lower for vegetation. It is concluded that this quantity cannot be used to distinguish sources of petroleum and that its use to determine the origin of soil hydrocarbons requires an accuracy of measurement not hitherto attainable.

E. I. R.

186. The Magnetic Field Over Igneous Pipes. V. J. Blum. *Geophys.*, 1945, **10** (3), 368.—This paper gives the results of a magnetic survey in the Canon City area, Colorado. Particular attention is given to the traverses made across two exposed igneous pipes about 40 ft in diameter. E. I. R.

187. Analysis of Oblique Reflection Data. C. W. Horton. *Geophys.*, 1945, **10** (2), 186.—In regions where the reflecting layers have large dips it is difficult to interpret reflection data if the shot-point and the instrument-spread do not coincide. In this paper rigorous methods of locating the reflection-point and of determining the magnitude and direction of the dip are given. Two approximate solutions are discussed in detail and by means of theoretical considerations and numerical examples it is shown that the errors introduced by the approximations are adequately small.

E. I. R.

188. Computation of Output Disturbances from Amplifiers for True Wavelet Inputs. N. Ricker. *Geophys.*, 1945, **10** (2), 207.—It is important that the geophone–amplifier–galvanometer system used in seismic prospecting should produce minimum distortion of the seismic wavelets received. Once such a system has been built it can easily be tested for distortion by the use of a shaking table. However, it is better to build only those systems which will be theoretically suitable. The appropriate theory is given in detail in this paper. E. I. R.

189. Repeated *P*-waves in Seismic Exploration of Water-covered Areas. R. L. Lay. *Geophys.*, 1945, **10** (4), 467.—A secondary, and even a tertiary, *P*-wave has been observed under certain conditions in seismic exploration of water-covered areas. As these multiple events are caused by an oscillation at the shot point it is suggested that the gas bubble formed as a result of the explosion is the seat of the effect observed. This oscillation can be prevented by bringing the charge close enough to the surface of the water, so that the gas bubble would burst through the surface on first expansion.

E. I. R.

190. Effect of Ray Curvature upon Seismic Interpretations. E. J. Stulken. *Geophys.*, 1945, **10** (4), 472.—The purpose of this paper is to provide some evaluations of the errors traceable to neglect of path curvature. For parabolic variations of velocity with depth, the inaccuracies of velocity, depth, dip, and offset determinations based on straight path assumptions are illustrated graphically.

Certain fallacies attending the application of simple curved path procedure to seismic prospecting are considered briefly so that a reasonably fair evaluation of net importance of the ray curvature problem may be attempted. E. I. R.

191. Refraction Waves Reflected from a Fault Zone. W. B. Robinson. *Geophys.*, 1945, **10** (4), 535.—A seismograph project in Webb County, Texas, yielded many records with seismic events which displayed step-out times far in excess of those of normal reflexions. The energy is assumed to travel along a marker horizon, as an

ordinary refraction wave, to a fault zone where it is reflected and returns to the detector as a refraction wave. The positions of the faults determined by this hypothesis show remarkable agreement with those mapped by the ordinary reflexions on the records.

Possible confusion that may arise from failing to recognize these anomalous events is discussed as well as the possibility of using the phenomenon to map faults.

E. I. R.

192. The Review and Analysis of Seismic Data. E. D. Alcock. *Geophys.*, 1945, **10** (3), 338.—It is proposed that separate departments be established for the review and analysis of seismic data. The functions of these departments would be to review and submit independent interpretations of current seismic data, to review old seismic data in the light of new geological and geophysical developments, to compile and prepare regional seismic maps and to investigate areas in which seismic and geological data do not conform. This paper discusses the benefits to be expected from such a programmme, the source of man power and the costs. E. I. R.

193. Measurement of Soil-Air Ions over the Fort Collins Anticline. R. M. Tripp. *Geophys.*, 1945, **10** (2), 238.—In escaping from the subsurface oil reservoir to the surface, gaseous hydrocarbons cause considerable evaporation of water from the near-surface soil. Some radioactive compounds, which are in a state of saturation over a large area because of their very low solubility products, are thereby precipitated in the soil. The field procedure consists of measuring the rate of ionization of the soil air over the structure. The results of such a survey over the Fort Collins anticline are compared with the previously known structure. E. I. R.

194. Thermodynamics of a Gas Migrating Vertically Through the Sedimentary Column. R. M. Tripp. *Geophys.*, 1945, **10** (2), 229.—The thermodynamics of gaseous hydrocarbons reaching the earth's surface by diffusion through the semi-permeable geological column is discussed. The possibility of using the physical, chemical, or biological changes, thereby produced in the local environment, as a means of locating the oil reservoir are also briefly discussed. E. I. R.

195. New Type of Seismic Cross-section Wherein Accuracy of Representation is Rendered Insensitive to Velocity Error. P. P. Gaby. *Geophys.*, 1945, **10** (2), 171.—A method is presented which was designed to: (1) Simplify computations in areas where velocity is known to vary, or may later be found to vary, laterally; (2) Considerably reduce the amount of recomputation necessitated by subsequent revisions in velocity.

The conventional time-section and time-map satisfy these requirements but are indicated generally to be subject to serious errors, as illustrated. The proposed system is explained and evaluated. Advantages believed to be peculiar to it are tabulated, and a practical method of plotting the cross-sections is presented.

E. I. R.

196. Interpretation of Well Shot Data. Part II. C. H. Dix. *Geophys.*, 1945, **10** (2), 160.—The determination of the velocity-depth relationship by five different well shooting techniques is described. Methods are also given for the detection of interference due to energy being transmitted down the cable by which the geophone is suspended. E. I. R.

197. Flying Eye for Oil Exploration. Anon. *World Petrol.*, 1946, **17** (9), 44.—The magnetic airborne detector is suitable for marine work, and is valuable in areas where erratic surface magnetic influences make ground readings of little value.

G. D. H.

198. Validity of Data from Airborne Magnetometer. H. Jensen. *World Petrol.*, 1946, **17** (9), 45.—The airborne magnetometer provides continuous records and so interpolation on maps is better than for ground surveys. Corrections for drift and diurnal variation are simplified. Extraneous anomalies are reduced in effect. The effects of small bodies such as patches of magnetic sand are capable of separation from major features by their rapid attenuation on a continuous record.

There is a lag in response which displaces signals along the line of traverse, and there is a non-linear frequency response which enfeebles small anomalies that show up as

high-frequency signals on the magnetic tape. These features have not been fully examined, but it is believed that they can be reduced in importance. Except in the case of detailed magnetic measurements made at intervals of only a few feet, the airborne magnetometer shows advantages over ground measurements. G. D. H.

199. Operational Procedure for the Airborne Magnetometer. H. Jensen. *Oil Gas J.*, 13.7.46, **45** (10), 80.—The airborne magnetometer gives continuous profiles, each of which needs only minor adjustments for diurnal variation and instrumental drift. Flight control is most important. This may be by radar or by aerial photographs and maps. The flying height is suitably controlled.

In addition to a series of parallel profiles, a base-line intersecting these at right-angles is flown to tie the profiles together. The base-line is flown in both directions, and the values are averaged. In this way it is possible to construct a self-consistent contour map of the total magnetic intensity. Regional corrections can readily be applied. G. D. H.

200. The Fluorgraphic Method of Petroleum Exploration. O. E. Campbell. *World Petrol.*, 1946, **17** (3), 54.—Fluorescent surveys over a series of oilfields have established that they give evidence of the presence of oil, and approximately outline the accumulation. Samples are exposed to ultra-violet light, and the fluorescence is recorded photographically under standard conditions. The image density is measured by a transmission photometer. The instrument can cover a wide range of fluorescent intensities. Both surface and subsurface samples are used.

Generally in surface surveys a quarter mile grid is employed, but for detail smaller intervals may be used. The average survey covers about 25 sq. ml. One ounce samples are taken at a depth of 2 ft by augering. Weather and topographic situation do not affect the obtaining of satisfactory samples. In average terrain the field cost is $30/sq. ml.

Isofluor lines are constructed and considered in conjunction with local geological and development data. Accumulations due to porosity conditions, lensing and pinch-outs, give the simplest contour forms, the area of local closure coinciding with the area of production. The Griffin pool has a minimum anomaly. Faults also give characteristic patterns.

Every significant fluorescent anomaly is a maximum compared with the local background. In some cases the area of highest fluorescent intensity is not over but around the oil reservoir. Insignificant minima without high rims frequently occur on the regional background.

The average maximum cost of laboratory and interpretative work is about $70/sq. ml.

Fluorlogs are obtained by using cuttings, even when the cuttings are several years old. Composite samples covering 200 ft are examined until a critical value of fluorescence is noted, and then the components are examined. All samples are tested for "fixed" and "free" fluorescence—the former is directly from the sample and the latter from its oil and gas. In productive wells the fluorescence intensity increases with depth to a maximum in the reservoir rock. Lateral indications are revealed. The average cost is 5 cents/ft. G. D. H.

201. Gravimeter Operations in the Foothills Belt of Alberta, Canada. W. K. Hastings. *Geophys.*, 1945, **10** (4), 526.—As part of a gravimeter survey in western Alberta, Canada, the work was extended into quite rugged areas of the Rocky Mountain Foothills belt. This paper outlines the general methods of operation, carried out on horseback from a movable camp, which were employed where conventional methods, using trucks, were impossible. Gravity observations were made with a new, small type Gulf gravimeter which, complete with batteries and other accessories, weighs about 48 lb. The reduced gravity results were quite smooth and regular in spite of rugged topography and terrain corrections running up to 7 milligals. E. I. R.

202. The Narrow-band Resistance-Coupled Amplifier. L. G. Cowles. *Geophys.*, 1945, **10** (3), 394.—The vacuum tube amplifiers used in geophysical applications are almost exclusively resistance coupled; it is a common requirement that these amplifiers have a relatively narrow-band frequency response. The characteristics and limitations

of this type of amplifier are discussed and design data given so that the circuit elements can be obtained when the band width, peak frequency, and peak frequency coupling loss are known. The design procedure is illustrated by several practical examples.
E. I. R.

203. Shoran : Precision Radar. S. W. Seeley. *Oil Gas J.*, 6.7.46, **45** (9), 74.—Tests in Florida show that Shoran gives an error of less than 50 ft in distance at its range limit of about 250 ml. In Shoran a radio set in a plane sends out pulses which are picked up by two ground stations and re-transmitted, the double journey from plane to ground stations being timed. The plane flies on an arc centred on one of the ground stations, its path being maintained by a refined type of pilot direction indicator meter.
Brief notes are given on the mode of operation of the equipment. G. D. H.

204. Torsion Balance Step Anomalies in Northern Tillman County, Oklahoma. K. Klaus. *Geophys.*, 1945, **10** (4), 507.—In 1943 a torsion balance survey was made in the southwestern rim of the Wichita Mountains, Oklahoma. This survey contains two step anomalies which are interpreted as associated with a large subsurface fault, with an indicated throw of the order of 10,000 ft. The results are shown by a gradient-curvature map, a gravity map, two-second derivative contour maps, and gravity and second derivative profiles. E. I. R.

205. Geophysical Activities in 1945. C. A. Heiland. *World Petrol.*, 1946, **17** (3), 52.—During 1945 the average number of geophysical crews at work was 562, compared with 451 in 1944. Seismic crews totalled 361, and gravity meter crews 172. In 1945 the oil industry spent an average of $3,249,000 per month on seismic work, $774,000 per month on gravity meter work, and $72,500 per month on magnetometer and other work, giving a total of $49,500,000 for the year, with a further $5,700,000 spent on well-logging.
19,000 of the 25,800 wells completed in 1945 were electrically logged.
Foreign geophysical work, mostly in the Caribbean and South American areas accounted for an average of 60 seismic, 30 gravity meter, and some geochemical and magnetometer parties, and was nearly 50% above the 1944 level. Russia at times operated as many as 25 electrical and 30 seismic parties in the Syzran and Saratov areas. Some geophysical work was carried out in England.
Continuous profiling technique was applied in refraction shooting, while there was further use of fluorographic and " surface temperature " (12–75 ft) methods of exploration. The airborne magnetometer was tested on oil structures in Oklahoma and Alaska. G. D. H.

206. Early Seismic Discoveries in Oklahoma. B. B. Weatherby. *Geophys.*, 1945, **10** (3), 345.—The Seminole Plateau in central Oklahoma was the proving ground for the reflexion method of seismic prospecting. The seismic predictions made during 1927 and 1928 were only partially confirmed by subsequent drilling, but as a result of this work the chief difficulties were overcome. In 1929 the South Earlsboro Pool was discovered, in 1930 the North Extension of Carr City Pool and the West Seminole Pool, and in 1931 the Polo Field, by the use of this method. Complete histories, maps, and records of these discoveries are given. A comparison of the results obtained on the Polo Field in 1931 and 1934 show the great advances that were made during this period. E. I. R.

207. Gravity and Magnetic Investigations at the Grand Saline Salt Dome, Van Zandt Co., Texas. J. W. Peters and A. F. Dugan. *Geophys.*, 1945, **10** (3), 376.—In order to secure additional information on the physical properties of a typical East Texas salt dome, detailed gravity and magnetic surveys were made at the Grand Saline Salt Dome in May 1944. The surface observations covered an area of approximately 60 sq. ml. and a subsurface gravity survey was made in the Morton Salt Mine. A quantitative interpretation of the results is given. E. I. R.

208. Organization of Geophysical Parties for Foreign Exploration. C. H. Dresbach. *Geophys.*, 1945, **10** (2), 137.—In the future an increasing percentage of the U.S. oil industry's exploration activities will be conducted in countries other than the United

States. The purpose of this paper is to give some idea of the difficulties that may be encountered in such work and how they may be overcome. Such subjects as living conditions, health, language difficulty, personnel, transportation, equipment, supply organization, and programme planning are discussed. The importance of choosing personnel of strong and trustworthy character is considered the greatest guarantee of success. E. I. R.

209. Trends in Geophysical Exploration. J. F. Anderson. *World Petrol.*, 1946, **17** (3), 43.—Seismic exploration reached a peak in the middle of 1945, a peak limited only by the lack of further crews. The number of geophysical contract crews has been trebled in the past four years. American companies are preparing to do the bulk of foreign contract geophysical work.

Special forms of reflexion and refraction detail shooting have been developed for deep flank exploration of salt domes.

There has been closer integration of geology and geophysics in the daily interpretation of seismic field data conducted in district headquarters near the site of operations. G. D. H.

Drilling.

210. Construction of Britain's Largest Oil Well Drilling Rig. Anon. *Oil Engine*, 1946, **14**, 260.—The latest equipment for drilling down to 10,000 ft using 4½-in drill pipe in oilfields overseas is described and is known as the Ideal (Type 100) Consolidated Rig.

The plant group consisting of draw works and one slush pump is powered by two Paxman Vee type, Mark 12 r.p.h. engines of 7-in bore and 7¾-in stroke, having a rated output of 355 b.h.p. at 1000 r.p.m. or 400 b.h.p. at 1200 r.p.m. Provision is made for a similar engine driving an additional pump if required. Each engine is mounted on a separate skid frame together with shaft extension supported on self-aligning roller bearings. Power drive to the draw works and the compounding drive are by 1¼-in pitch triplex chain. The pump drive is by Vee belt. The engines are directly coupled to their respective shafts by Bibby couplings and Vulcan–Sinclair scoop controlled couplings.

Air for the air-operated friction clutches for all hoisting and drilling operations is obtained from an Ingersoll–Rand compressor mounted on an extended frame and driven by Vee belt from No. 1 engine. The slush pump driven from No. 2 unit by 20 1¼-in Vee ropes and mounted on skids has a maximum working pressure of 3000 lb/sq. in at 55 r.p.m.

Constructional details and operation of the draw works, all the controls of which are situated at the drillers stand, are described. It is built into two units, each on its own skid frame and bolted together permitting transportation on highways with a minimum road clearance of 8 ft wide. C. D. B.

211. Drilling Equipment Needs. D. Ragland. *Petrol. Engr Reference Annual*, 1945, **17** (10), 72. (*Paper presented before American Association of Oil-Well Drilling Contractors. Oklahoma, October* 1945.)—A preliminary analysis is made of drilling costs with respect to depth. The possibility of decreasing these costs by fundamental improvements in equipment, giving longer life and requiring less labour, is then discussed. The subject is treated from the aspects of drilling the hole, coring, and evaluating formations, casing, cementing, and completing, and rig maintenance. R. B. S.

212. Trends in Drilling Costs in California. R. W. Marshall and R. C. Sharp. *Petrol. Engr Reference Annual*, 1946, **17** (10), 61. (*Paper presented before Pacific Coast District Div'n of Production A.P.I. Los Angeles, April* 1946.)—An analysis is made of rigging-up, drilling and completing time, and operating costs per day, of 1187 California wells varying in depth from approximately 2000 to 13,000 ft, during the years from 1936 to 1945 inclusive. In all 12 graphs and 2 tables are presented. R. B. S.

213. The Drilling Well at Sea. Anon. *Oil Gas J.*, 2.11.46, **45** (26), 62.—The development of a submarine field off the shores of Louisiana is described. First deep test, on one of Magnolia's five large blocks leased from the state of Louisiana, is located

about 37 miles south of Morgan City, 10 miles from Eugene Island Lighthouse and approximately 5 miles from Point Au Fer, the nearest land. While a number of wells along the Gulf Coast and in the Pacific Coastal area have been drilled in water, this operation is the first carried on at such a distance from the shore. The sleeping quarters are on a houseboat especially fitted for the purpose. The rig is erected on pilings. Communication is maintained by radio. Although a brackish water well has been completed at the rig, its supply is inadequate and over 500 brl of fresh water for drilling mud must be hauled from shore. Well-sample cuttings are collected from the mud returns every 30 ft. An electric log is run every 500 ft, with sidewall cores being taken in likely appearing sands. Palæontological determinations and electric-log correlations are made for comparative purposes with the nearest wells over 5 miles away. The operation, Magnolia's 58 Louisiana Gulf Block, is drilling at 9049 ft. A. H. N.

214. Drill-Pipe Yield Strength Lowered by Severe Drilling Service. W. O. Clinedinst. *Oil Gas J.*, 2.11.46, **45** (26), 76.—At times drill pipe must withstand high bursting pressures, at others high collapsing pressures, sometimes axial tension loads, and sometimes axial compression. In addition, it must transmit the torque required for drilling. Not the least in its service, it must endure bending due to sidetracking and lack of straightness of hole, as well as that resulting from column-buckling action under compression loads. It is believed that flexural stresses are the principal contributors to fatigue of drill pipe, while torsion, axial stresses, vibratory stresses, and those caused by pressure differentials contribute to a lesser degree. Occasionally, samples of drill pipe returned from service for metallurgical examination have displayed yield strengths considerably lower than would be expected from the manufacturing records of the steel heat represented by the particular pipe. This suggested that the yield strength may have been altered by the alternating stresses in drilling. Experimental data are presented showing the effect of fatigue on drill-pipe steel. A curve shows a very rapid increase to a maximum followed by a steep decrease in the yield strength as repeated stress is maintained for longer periods or made a larger proportion of the endurance limit. A. H. N.

215. Casing Sanding Practice. J. P. DeHettre. *Petrol. Engr Reference Annual*, 1946, **17** (10), 104. (*Paper presented before Pacific Coast District Div'n of Production A.P.I., April* 1946.)—See Abstract No. 860 (1946).

216. An Investigation of Oil Well Cementing. A. J. Teplitz and W. E. Hassebroek. *Petrol. Engr Reference Annual*, 1946, **17** (10), 114. (*Paper presented before S.W. District Div'n of Production A.P.I., Shreveport, May* 1946.)—This paper describes a thorough experimental study of the physical processes occurring during the cementation of casing. The results of many tests which were made using carnotite as a tracer are given. The information was obtained in a variety of ways, including electrical, caliper, radioactivity, and temperature logging. The experiments performed showed that extensive channelling of cement occurs in the ordinary procedure of casing cementation and that this condition is responsible for most of the failures encountered. It is suggested that channelling can be reduced, and even practically eliminated, by properly equipping the casing with scratchers and centralizing devices, by reciprocating the pipe whilst placing the cement, and by speeding up the rate of pumping.

In the case of squeeze cementing the physical changes which occur underground during the cementing process are not fully understood. It seems that in some cases squeeze cementing may even be harmful to producing formations. It is recommended that a further study of this type of cementing be made in order to reduce the hazards involved.

Five references are appended. R. B. S.

217. Improved Drilling Muds Containing Carboxymethylcellulose. H. H. Kaveler. *Petrol. Engr Reference Annual*, 1946, **17** (10), 93. (*Paper presented before Mid-Continent District, Div'n of Production, A.P.I., Oklahoma, June* 1946.)—See Abstract No. 1041 (1946).

218. Results and Use of Oil Base Fluids in Drilling and Completing Wells. G. V. Kersten. *Petrol. Engr Reference Annual*, 1946, **17** (10), 80. (*Paper presented before Pacific Coast District Div'n of Production, A.P.I., Los Angeles, April* 1946.)—See Abstract No. 744 (1946).

Production.

219. Application of Petroleum Engineering to Drilling and Production Work. B. Thomas. *Petrol. Engr Reference Annual*, 1946, **17** (10), 174.—This paper is an excellent summary of the problems confronting the petroleum engineer and of the most important trends and developments during recent years in the application of petroleum engineering to drilling and production work.

One of the most pressing needs for the application of petroleum engineering is in the field of reduced drilling costs. An example of the hazards which increase drilling costs is that of stuck drill pipe, which can be caused by (1) heaving shale, (2) high filtration muds (which lead to the build-up of thick filter-cakes on the walls of the well), and (3) caving of the walls of the hole: each of these problems needs to be overcome more satisfactorily, and yet cheaper, than at present. Slim hole drilling, which was originally proposed as a means of reducing drilling costs, is considered to introduce many disadvantages, and the trend is now towards the use of larger diameter drill pipe but *without a corresponding increase in hole size*. The pressure loss of mud in drill pipe is thus decreased and mud return velocities are increased by virtue of the smaller annular space between the drill pipe and walls of the hole: both results are advantageous. The problem of lost mud returns is a very serious one and the various remedies developed, which include: (1) the use of fibrous materials in the mud; (2) the use of cement; and (3) drilling with water without returns, are not entirely satisfactory in reducing costs. Again, many of the hazards involved in such operations as marine drilling are as yet unsolved.

However, many advances have been made in drilling technique. Increased bit footage is possible as a result of improvements in bit design and manufacture. Drill-pipe service has been increased by changes in tool joint design, better threads, and better thread lubricant. Blowout hazards have been reduced by considerable improvements in control equipment. Considerable economies have been effected by the application of engineering to casing and tubing strings, and considerable savings in transportation, setting up, and tearing down of drilling rigs have been effected by careful planning of the entire rig lay-out. Other improvements have been in the fields of well logging, directional drilling, drilling-time studies, oil-well cementing, water treating, fuel economy, and rig equipment.

The newly developed science of reservoir engineering constitutes an important application of petroleum engineering in the production of oil. Conservation of the original reservoir energy is a prime objective and the type of well completion determines the extent to which reservoir energy will be conserved and utilized. For this reason the reservoir conditions and type of drive must be recognized as early as possible in the life of a new field so that the proper well completions can be made. In addition to reservoir rock and fluid analyses and production data, a complete geologic picture is essential to proper evaluation of reservoir conditions. The many advantages of detailed reservoir studies are outlined and other factors discussed in this connexion are conservation, proration, well spacing, pressure maintenance, and secondary recovery.

Well cleaning and repair, salt water disposal, artificial lifting, separation of well fluids, and control of corrosion are other production jobs in which the petroleum engineer may be called upon to assist. The nature of work which should be handled by a petroleum engineering laboratory and its importance is also discussed. Finally, the management of materials, reporting on operations, and the control of expenditures are discussed.

This lengthy paper is in itself a review and should be read in its entirety to be fully appreciated. R. B. S.

220. Trends and Developments in Petroleum Production Engineering. S. E. Buckley. *Petrol. Engr Reference Annual*, 1946, **17** (10), 154. (*Paper presented at 31st Annual Meeting, Amer. Ass. Petrol. Geol., Chicago, April* 1946.)—This paper is a review of developments in petroleum reservoir engineering from 1941 to 1945. The author's

opinion is that the most important development in this sphere of petroleum engineering during this period has been the inauguration of the transition from the qualitative to the quantitative stage. This development of quantitative production technology is briefly discussed in so far as it concerns: (1) the fluid properties of the oil, gas, and water that occupy petroleum reservoirs; (2) the characteristics of producing formations; (3) the chemical and physical behaviour of the fluids in the reservoir sands; (4) the behaviour of wells, including their testing completion, production, and repair; (5) the characteristics and behaviour of petroleum reservoirs; and (6) the inter-relation between reservoirs and their surroundings.

Nine references are given. R. B. S.

221. **Interpretation of Well Test Data in Gas-Condensate Fields.** J. O. Lewis. *Petrol. Tech.* (*A.I.M.M.E.*), July 1946, **9** (4), 1.—The operation of gas-condensate fields is comparatively new and involves principles not hitherto applied in gas and oil production. It has been necessary to devise new methods of testing gas-condensate wells, and for correlating laboratory and field data. Various new methods are described for interpreting well-tests giving the natural gasoline content of the gas, in order to detect dilution by dry gas, and to provide data on the re-vaporization of condensates within the reservoir. Inaccuracies in the well-test data are discussed. Changes in flow-rates involve pressure changes, and so give rise to changes in the natural gas content of the effluent, and after an important change in flow-rate a considerable time may be needed to reach stability. Retrograde condensation studies as usually made cannot ordinarily be directly compared with field data on the natural gasoline content of gas, because the former generally include solution gas in the condensates, which are reported on a cumulative basis, whereas the latter usually record pentanes plus on a rate or instantaneous basis. G. D. H.

222. **Rôle of Bacteria in Oil Production.** J. V. Beck. *Producers' Monthly*, July 1946, **10** (9), 29. (*Paper presented at Annual Meeting, Pennsylvania Grade Crude Oil Association, Pittsburgh, June* 1946.)—A brief explanation of bacterial life is given: less than 1% of the total species of bacteria known today are harmful to mankind. Most bacteria are useful to mankind: they are essential for the rôle they play in plant and animal life, whilst many industrial processes depend on some kind of bacterial activity.

Since bacteria require both an aqueous system in which to grow and the presence of organic matter as a source of energy, one might expect bacterial activity to occur at oil–water interfaces, which are of frequent occurrence in production. It is believed that some species may be utilized in oil-producing operations, whilst others may be harmful and must therefore be controlled. The present paper is intended to present a plan of action on several bacteriological problems, and to discuss some of the things which are under investigation.

Sulphate-reducing bacteria are active in many input lines and some corrosion problems are due to their activity. The products of corrosion by such bacterial action tend to cause plugging of the sand face. Laboratory studies have shown that formaldehyde at a concentration of 40 p.p.m. is most effective in killing sulphate-reducing bacteria. Chlorine is an excellent bactericide but its activity is destroyed by contact with most organic matter.

However, some types of bacterial action are beneficial. Certain bacterial species are able to oxidize paraffin and attempts have been made to culture these species and use them to decompose the paraffin at a sufficiently rapid rate that its separation from the bulk of the crude will be prevented. This will make it unnecessary to stop production to remove the paraffin from the well or the lines by mechanical means. Bacteria may also play another rôle in petroleum production by their action in releasing oil from producing sands, both directly, by their greater affinity than oil for the sand surface, and also indirectly, by the production of carbon dioxide which acts to increase pore size and reduce oil viscosity and by the production of detergents which increase the efficiency of displacement of oil by water.

Six references are appended. R. B. S.

223. **Experimental Flowing of Oil Wells on Air-Injection Projects in Pennsylvania.** B. F. Grant and R. B. Bossler. *Petrol. Engr*, July 1946, **17** (11), 103; *Producers' Monthly*, July 1946, **10** (9), 38.—An account is given of the experimental work which

has been done during the last two and a half years in the Venango County (Pennsylvania) district, to determine the feasibility of utilizing the reservoir energy created by air or gas injection to flow the oil from producing wells on secondary recovery projects. On these projects oil is produced from the Venango sands (Upper Devonian) at depths ranging from 300 to 1000 ft and daily oil-production rates range from 0·1 to 2·5 brl per well with produced gas–oil ratios varying from 1000 to well above 10,000 cu. ft per brl of oil. Operating expenses per brl of oil produced by conventional methods is high and the necessary maintenance of pumping equipment accounts for a large proportion of this expense.

The conversion of producing wells from pumping to flowing was considered as a means of reducing these operating costs, which might also result in decreased by-passing of the injected medium and therefore lead to more efficient recovery. The requirements for such a scheme are: (1) Enough pressure must be established and maintained in the reservoir by air or gas injection to cause the wells to flow; (2) the design and installation of flowstrings must be made practicable for the range of conditions found on a particular property; (3) the expected oil production rate by flowing the wells should not be materially less than that obtained by pumping the wells; and (4) the cost of converting the wells from pumping to flowing should be amply repaid by the lower operating costs of flowing production.

Each of these requirements is discussed in detail. Eight references are given.

R. B. S.

224. Selective Plugging by Smokes in Air–Gas Drive. R. F. Nielsen and S. T. Yuster. *Petrol. Engr Reference Annual*, 1946, **17** (10), 134. (*Paper presented at the Ninth Technical Conference on Petroleum Production, Pennsylvania State College, November* 1945.)—The possibility of using dusts and smokes (aerosols) as selective plugging agents in air or gas drives is discussed and compared with the use of aquasols (such as wax dispersions) in water injection operations. The use of smoke involves a number of difficulties not encountered in the use of aqueous dispersions. Smokes are less stable than aqueous dispersions and show a greater tendency to adhere to pipes and other equipment; in consequence they must be manufactured directly in the air or gas line at or near the injection well-head. Another disadvantage is that the rate of coagulation increases with particle size at a greater rate than that for aqueous dispersions, and thus it is more difficult to obtain the proper particle size for selective plugging. In addition, the material should be easily soluble in a cheap solvent so that the sand may be unplugged if desired, and also the risk of explosion should be kept to a minimum.

The first laboratory experiments which are described were conducted with fine powders having an ultimate particle size down to a fraction of a micron. These were not very satisfactory, however, as they could not be sufficiently dispersed by simple means to give selectivity in the permeability range desired, and were only suitable for excessively high permeabilities.

A second set of experiments are described which were designed to test the value of smokes, prepared by either chemical or condensation methods, for this work. Smokes prepared by the condensation method had a selectivity in the range from 90–700 md., as was expected from the laws of filtration. Observations were also made on the tendency of smokes to stick to pipes, etc.; and other factors involved in the production of smokes for field use, such as thermal balance calculations and equipment design are discussed. Only two references are appended. R. B. S.

225. Progress on Selective Plugging Studies by Chemical Methods. H. Lawton. *Producers' Monthly*, July 1946, **10** (9), 32. (*Paper presented at Annual Meeting, Pennsylvania Grade Crude Oil Association, Pittsburgh, June* 1946.)—Among the advantages to be gained from selective plugging of sands are: (1) decreased by-passing of water and gas through thief sands; (2) lowered pumping costs; and (3) increased input into the less permeable sands with resultant increased rate of oil recovery.

Laboratory and field experiments on the preparation and use of silica gel forming solutions and urea–formaldehyde resin forming solutions as selective plugging agents are described in detail. Much of the literature on the use of the former for this purpose is also reviewed.

The effect of acid concentration on the rate of gelatination for silica gels containing various concentrations of silica from 8·8% to 13·2% is shown tabularly and graphically. As a result of these tests a gel forming mixture containing 12·2% of silica was selected as the most suitable for field use.

The most suitable composition for the urea–formaldehyde mixture was found to be one part each by weight of ammonium chloride and hexamethylenetetramine, 100 parts by weight of urea, and 263 parts by weight of 37% formaldehyde solution. The effect of varying the amounts of these constituents on the properties of the final mixture are also discussed.

The field treating procedure is also described, and ten examples are given. Twelve references are appended. R. B. S.

226. North Coles Levee Pressure Maintenance Project Control of Gas Expansion. W. J. Travers. *Petrol. Engr Reference Annual*, 1946, **17** (10), 144. (*Paper presented before Pacific Coast District Div'n of Production, A.P.I. Los Angeles, April* 1946.)—The Geology and Development history of the North Coles Levee oilfield in the San Joaquin Valley is described in detail. During the initial period of rapid development no information was available on the rate of gas expansion or possible edge-water encroachment. Later a close pressure control was enforced and the initial high gas–oil ratio wells were shut in to conserve reservoir energy: Reservoir pressure then showed a slow decline and there was no evidence of water encroachment.

After a sufficient number of wells had been completed to determine the reservoir characteristics an intensive study was made to select the most advantageous method of exploiting this relatively deep and high pressure, low permeability reservoir. Gas injection was decided upon, and gas is now injected at a surface pressure of 3300 lb/sq. in. into five injection wells. One of these is a combination injection and producing well, the completion of which is described in detail. The remedial operations for the improvement of producing wells are also described and the improvement in production and % recovery expected due to the combined effect of gas injection and remedial operations is discussed. R. B. S.

227. Pressure-Controlled Intermitters. G. Weber. *Oil Gas J.*, 26.10.46, **45** (25), 94.—Pressure-controlled intermitters are best adapted to wells showing two characteristics: (1) low fluid levels in the anulus between casing and tubing, and (2) erratic casing-pressure build-up following shut-in. Such wells will not flow continuously on a fixed choke setting at uniform pressures. They are commonly high-ratio producers when flowed manually since they show a marked tendency to "blow" dry gas after varying periods of oil production. This is caused by a decline in the bottom-hole pressure, which allows built-up casing pressure to depress the annular fluid column to the bottom of the tubing string, breaking the fluid seal and allowing gas to by-pass oil. When flowed manually, this type of well requires close watching if gas blowing is to be prevented. Installation of smaller chokes extends the flowing period before the liquid seal is broken, but requires longer flowing time to make allowables, or reduces daily production. Time-cycle intermitters which allow flow between fixed intervals of time determined by clock settings, find wide adoption on such wells, reducing labour costs and better adapting well-flow to individual well conditions. Other types of intermitters operate on actual well-pressure and flow and shut-in wells at predetermined casing pressures, thus regulating flow with relation to the liquid level in the casing. Field trials of different schemes and types are reported for wells varying in pressures from 150 to 1500 lbs/sq. in, and in periods from once every 45 seconds to once every half day. Satisfactory results are reported.
A. H. N.

228. Gas Recovery Systems. D. Rogers. *Petrol. Engr Reference Annual*, 1946, **17** (10), 196. (*Paper presented before Eastern District Div'n of Production, A.P.I. Pittsburgh, June* 1946.)—See Abstract No. 1358 (1946).

229. Practical Economic Problems of Secondary Recovery. J. P. Jones and H. Rich. *Petrol. Engr Reference Annual*, 1946, **17** (10), 140. (*Paper presented at Annual Meeting, North Texas Oil and Gas Association, Wichita Falls, March* 1946.)—Some of the factors which should be considered in determining the economic possibility of a

successful secondary recovery water-flood operation are briefly discussed. The amount of recoverable oil remaining in the sand, the permeability ranges, and well spacing are the most important factors: the variation of permeability throughout the sand body is particularly important. The operating costs involved and other engineering advice necessary are also discussed. Finally, the importance of secondary recovery research is stressed. R. B. S.

230. Relation Between Well Spacing and Recovery. W. V. Vietti, J. J. Mullane, O. F. Thornton, and A. F. Van Everdingen. *Petrol. Engr Reference Annual*, 1946, **17** (10), 51. (*Paper presented at 25th Annual Meeting, A.P.I., Chicago, November* 1945.)—See Abstract No. 863 (1946).

231. Secondary Recovery Production Research (A Monthly Review): A Review of Penn Grade Production Research. R. V. Hughes. *Producers' Monthly*, July 1946, **10** (9), 20. (*Paper presented at Annual Meeting, Pennsylvania Grade Crude Oil Association, Pittsburgh, June* 1946.)—This paper, which is a review of some of the important research work now in progress at the Association's laboratories, deals almost entirely with water-flooding. Laboratory experiments are being carried out in connexion with acidization, chemical plugging, core flooding, increasing oil recoveries, effects of clay content of producing sands, and micro-biological work.

The problem of selective shooting is discussed in so far as it affects Pennsylvania sands. The foremost requirement is an accurate log of the producing horizon; experiments which should then be carried out to obtain good results are: (1) to test the relative merits of solid, semi-solid, and liquid explosives under conditions of fluid tamping *versus* solid tamping and heavy tamping *versus* light tamping; (2) to evaluate the benefits of being able to increase the shot volume by drilling holes of larger diameter; and (3) to determine the relative responsiveness of a given shot upon well consolidated and upon poorly consolidated sands.

As a result of recent studies of water-flooding operations, it is now known that all input waters should have such physical and chemical characteristics that the clay content of the sands will not be dispersed. What is known about flood waters in this respect is briefly summarized and references are given to nine papers on this subject by the Association's workers. R. B. S.

232. Oil Production By Water. P. J. Jones. *Oil Gas J.*, 2.11.46, **45** (26), 64.—This forms the first part of a series of papers to discuss water injection for the purpose of producing oil. In this part definitions and elementary concepts involved in production of oil are discussed and explained. A. H. N.

233. Economics of Water Flooding. K. B. Nowels. *Petrol. Engr Reference Annual*, 1946, **17** (10), 190. (*Paper presented at Annual Meeting, North Texas Oil and Gas Association, Witchita Falls, March* 1946.)—Many facts and figures are presented to show the financial advantages of water-flooding operations. An index-number scheme is suggested as a quick means of making a rough estimate of the potential possibilities of a water-flood project. The necessity in the final analysis of a more detailed study based on core analysis information, is emphasized. R. B. S.

234. Increased Water Intake Rates by Acidization. R. J. Pfister. *Producers' Monthly*, July 1946, **10** (9), 24. (*Paper presented at Annual Meeting, Pennsylvania Grade Crude Oil Association, Pittsburgh, June* 1946.)—An efficient intake well is defined as one which moves the maximum oil to the producing well with a minimum amount of by-passing water: increased water intake rates only result in increased production, provided this efficiency is not impaired. The purpose of acidization is to remove filter-cake from the sand face and also to open solution channels in tight sands. Such treatment is usually most successful in limestone formations, but more recently sandstones have also been successfully acidized, with the development of special acids consisting of various mixtures of hydrochloric and hydrofluoric acids. Experiments have been devised to find the most economical method of carrying out such an acidization for the purpose of increasing water intake rates. These experiments, and the procedure to be adopted in carrying out this type of acidization, are described in detail.

Four references are appended. R. B. S.

235. Flood Tide in Illinois. F. Squires. *Producers' Monthly*, July 1946, **10** (9), 10.—The geographical position, production history, and geology of the Sigginș, Patoka, and McClosky fields of Illinois are described. These three fields are characterized by high permeability sands and they have all been successfully flooded: the problems which were encountered in the flooding operations are described. The results show that, for fields of this type: (1) permeability should be determined in the well itself by an injection method; (2) a reliable selective plugging method is needed; and (3) improvements in well-cementing methods are desirable. R. B. S.

236. Some Experiments on the Mobility of Interstitial Waters. R. G. Russell, F. Morgan, and M. Muskat. *Petrol. Tech.* (*A.I.M.M.E.*), July 1946, **9** (4), 1.—Radio-vanadium solutions have been employed as radioactive tracers in core experiments on the mobility of interstitial water. Sandstone cores saturated with the active water were first flooded with oil in order to create a condition simulating a virgin oil-sand. They were then subjected to flooding by inactive water, and measurements of the radioactivity of successive portions of the effluent, and of the core, were made. In other experiments the distribution of radioactivity along the core was measured during the flooding process. In further experiments cores fully saturated with active water were flooded with inactive water.

All the experiments showed that injection of a volume of inactive water equal to the pore volume of the core gave an effluent with more than 80% of the active material originally within the core. While it is possible that some tracer transfer can occur by diffusion, it is believed that the results indicate a high degree of mobility of the connate water during water-flooding. Thus the advance of the flood water will be slower than if the connate water were immobile. Appearance of water with oil in the production does not necessarily imply break-through, unless it agrees with the flood-water in composition. In order to obtain the connate water content of an oil-sand it seems desirable to core with crude oil or with oil-base muds. If connate water is displaced by invading water from the mud the resistivity values may be high, and the S.P. values may be changed, thus making interpretation of electric logs uncertain.

G. D. H.

237. Reduction of Sulphates in Oil-Field Water. F. B. Plummer and I. W. Walling. *Petrol. Engr Reference Annual*, 1946, **17** (10), 169. (*Abridged form of paper presented before Amer. Inst. Min. & Metall. Engrs, Tulsa, October* 1945 *and also Chicago, February* 1946.)—The presence of sulphate-reducing bacteria in oilfield waters causes chemical reduction of any soluble sulphates present, resulting in the liberation of hydrogen sulphide. If soluble iron salts are also present in the water, these react with the hydrogen sulphide and black iron sulphide is precipitated: often this becomes oxidized to iron hydroxide, which is also a precipitate, reddish-brown in colour.

Chlorine, the normal bacteria treatment, is not effective in killing sulphate-reducing bacteria, but experiments show that it takes ten days to two weeks for sulphate-reducing bacteria to develop in sufficient quantity to produce harmful amounts of hydrogen sulphide. Since injection water normally passes through an oilfield installation and is disposed of within 24 hours there are clearly some other factors which are also responsible for the formation of hydrogen sulphide.

The experiments, which are briefly described, show that: (1) the presence of colloidal iron sulphide increases the amount of hydrogen sulphide liberated for the same quantities of soluble sulphates and sulphate reducing bacteria; (2) iron rust, metallic iron, and metallic magnesium also accelerate the reaction; (3) without the presence of sulphate-reducing bacteria no sulphate reduction takes place, no matter what quantities of these other substances are present; and (4) the amount of reduction decreases with temperature under all conditions.

It is concluded that the reduction of sulphates in oilfield waters may be prevented or at least greatly reduced by: (1) cooling the water to below 70° F; (2) reducing the contact with iron equipment by suitable means; (3) aerating the water; and (4) using bactericides. The bactericides mentioned are formaldehyde, cresol, phenol, lysol, monochlorbutene, trichlorbutane, and creosote: these are not discussed in detail.

Seven references are appended. R. B. S.

238. Discussion of Technical Publications. *Petrol. Tech.* (*A.I.M.M.E.*), May 1946, **9** (3), 1.—There is brief discussion of the Technical Publications abstracted in Abstracts Nos. 1217 and 1296 (1945) and 453, 456, 753, 754, 1045, 1047, 1051 and 1059 (1946).

Oilfield Development.

239. New Production Record in 1945. Anon. *World Petrol.*, 1946, **17** (3), 47.—U.S.A. produced 1,740,000,000 brl of oil in 1945. Excluding service wells, 24,540 wells averaging 3500 ft in depth were completed, 58% gave oil and 12% gave gas. 4190 wildcats were completed, 13% finding oil and 3% finding gas.

The average depth of 1945 completions in Louisiana was 7000 ft.

Proven reserves amounted to 20,800,000,000 brl at the end of 1945, new discoveries having contributed 400,000,000 brl and extensions and revisions 1,700,000,000 brl during the year. G. D. H.

240. Domestic Production Only 3% Lower Than War-time Peak. C. J. Deegan. *Oil Gas J.*, 27.7.46, **45** (12), 136.—U.S. production in the first half of 1946 totalled 846,538,000 brl, only 23,264,000 brl less than in the corresponding period of 1945. The Texas production was down by 20,154,000 brl in the first half of 1946, and California was 11,046,000 brl down. The bulk of the Californian drop was due to closing in Elk Hills Naval Reserve. In Texas the main drops were at East Texas, Wasson, Agua Dulce, Tom O'Conner, and West Ranch.

A table gives by States the production for the first half of each year from 1940 onwards. G. D. H.

241. Wildcatting Declines but Upturn Expected. Anon. *Oil Wkly*, 26.8.46, **122** (13), 53.—During the first seven months of 1946, 2454 exploratory wells were completed in U.S.A., 25 fewer than in the same period of 1945. 21·4% of the 1946 completions were productive, 284 giving oil and being made up of 165 new field and 119 new pay discoveries. There were 93 extensions. 18·9% of the 1945 wildcats produced. 39 distillate discoveries have been made in 1946 and 77 gas discoveries.

351 exploratory wells were completed in July 1946. California had a new gas-field discovery, and Rangely a new pay. Production was extended 1 ml. east at Big Muddy. Illinois had six new pay discoveries and six extensions. The Hawkhead pool was opened in Michigan. Texas had 25 successes.

Tables summarize by States and districts the results of exploratory drilling in U.S.A. during July and the first seven months of 1946, while the July discoveries are listed with notes on the principal features. G. D. H.

242. California Exploration and Production Trends. N. A. D'Arcy. *World Petrol.*, 1946, **17** (3), 48.—New producing zones were found in 1945 at Edison (2300 ft) and Cymric (3600 and 4700 ft). 35 wells have been drilled to the Jurassic fractured schist at Edison. The Santiago pool in the Midway–Maricopa area produces from a steeply tilted lenticular body. Production has been found at a depth of 11,229 ft at Newhall-Potrero. A well on the McDonald anticline found oil at 853 ft.

Standard's KCL 20–13 was stopped at a depth of 16,246 ft.

22 discovery wells were drilled in California in 1945. 21 of these are credited to geology. Present trends are to supplement seismic work with deep core-holes. When production tests are required the small core-holes are reamed out to 6¾ in. New equipment has been developed for this work, and core rigs are being planned which will be capable of drilling to 10,000 ft, at an estimated cost of $2 to $4/foot.

Some submarine drilling is continuing in spite of the pending law-suit on these areas.

Recycling and repressuring operations are being conducted in several of the new high-pressure deep fields. Water drive and gravity drive is being tried in some fields. Several fields are now under unit operation. The Del Rey oilfield is being used for gas storage in order to meet seasonal peaks.

Brief notes are given on wildcats. G. D. H.

243. West Edmond Oilfield, Central Oklahoma. D. A. McGee and H. D. Jenkins. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1797.—The West Edmond oilfield of Central Oklahoma lies on the northeastern rim of the Anadarko Basin. The structure is

monoclinal, dipping west into the basin at 125 ft per ml. The field has produced more than 32 million brl of oil from 704 wells between its discovery in April 1943 and December 31, 1945. During the same period some 46,000,000 MCF of gas have also been produced. Seventeen of the 704 wells are producing oil from the so-called "Bartlesville sand" of Pennsylvanian age; while 687 wells give oil from the Hunton limestone of Siluro-Devonian age.

The proved acreage of the field comprises some 30,000 acres, while a further 1500 to 2000 acres are semi-proved. E. N. T.

244. Northern Mexico's April Output up 18%. Anon. *Oil Gas J.*, 6.7.46, **45** (9), 59.—The production from Poza Rica, Naranjos, and Panuco averaged 131,505 brl/day in April, 34% more than in January and 18% more than in March. G. D. H.

245. Seven Groups to Search Bahamas for Petroleum. Anon. *World Petrol.*, 1946, **17** (11), 45.—The Bahamas consists of 4400 sq. ml. of land on banks covering about 50,000 sq. ml. Concessions have been granted to four British and three American companies for oil exploration. Gravity meter and airborne magnetometer work is being undertaken. G. D. H.

246. Colombian Company Maps Exploratory Activities. Anon. *Oil Gas J.*, 22.6.46, **45** (7), 62.—Ariguani's wildcat I Costarica is now 8700 ft deep. It lies on a fault structure believed to be on a continuation of the Dificil and San Angel trends. Miocene shales with sand streaks extend down to 6313 ft. Gas and light oil shows were found in sand streaks at 2300–2320 ft, 3195–3205 ft, 3470–3480 ft, 4160–4170 ft, 4640–4660 ft, 5200–5220 ft, 5550–5570 ft, 6100 ft, 6220–6250 ft, and 6300 ft. G. D. H.

247. Colombian Wildcat now Coring Beyond 7481 ft. Anon. *Oil Gas J.*, 22.6.46, **45** (7), 63.—Velasquez 1 found 30° A.P.I. oil in a drill-stem test at 7254–7274 ft. It is now coring at 7481 ft. G. D. H.

248. Colombia Looks to Increased Activities. Anon. *World Petrol.*, 1946, **17** (3), 60.—72 wells were spudded in Colombia in 1945, and 47 of the 63 completions were producers. 19 wells were completed in the Infantas and La Cira fields. Galan Nos. 1 and 3 extended the Casabe field. Shell completed 9 producers at Casabe and 6 at Dificil. Socony-Vacuum brought in Cantagallo No. 6, and 9 successful wells were completed on the Barco concession.

34 wildcats were under way at the beginning of 1946. Two deep tests had been started at Tibu.

93 applications, covering 16,000,000 acres, were made for concessions in 1945.

About 22,630,000 brl of oil was produced in 1945, 15,560,000 brl coming from the De Mares concession, 5,450,000 brl from the Barco concession, and 1,530,000 brl from the Yondo concession. G. D. H.

249. Venezuelan Production Continues to Rise. Anon. *Oil Gas J.*, 22.6.46, **45** (7), 62.—Venezuela's April production averaged 1,043,330 brl/day, compared with an average of 1,006,379 brl/day for the first quarter of 1946.

Tables give the April production by fields and companies. G. D. H.

250. Venezuela Production Sets New Record in 1945. A. N. Sutton. *World Petrol.*, 1946, **17** (3), 62.—Venezuela produced 323,359,000 brl of oil in 1945, 66,325,000 brl more than in 1944. The peak production was 1,020,451 brl/day in November. Western Venezuela produced 218,492,000 brl, the Bolivar field yielding 186,862,000 brl.

533 wells were drilled in 1945, 403 being in Eastern Venezuela. There were 85 exploratory wells. In Eastern Venezuela the main activity was in the Jusepin–Mulata and Guara areas.

Shell discovered a new field in the district of Mara, 28 ml. northwest of Maracaibo. The oil is in a Cretaceous limestone at 6000 ft.

Tables show the 1944 and 1945 outputs by companies, and the yearly production since 1940. Some indication of the 1946 programme is given. G. D. H.

251. Continuing Search for Oil in Britain. A. H. Day. *World Petrol.*, 1946, **17** (10), 47.—A total of 28,346 sq. ml. has been under lease for oil prospecting in Great Britain, and of this 13,346 sq. ml. has been surrendered. The D'Arcy

Exploration Co. developed the Eakring area fields, which consist of simple domes with minor faults. Production is from sandstones in the Millstone Grit series and in the Lower Coal Measures. The crude is waxy. Over 400,000 tons of oil has been produced, mainly from this one area, and the 1945 output was 71,542 tons.

Anglo-American obtained some oil in Midlothian, but the results were disappointing. Traces of light oil were found in a well at Belton, but the formations producing at Eakring were absent at this spot. A well at Gringley, 12 ml. south of Belton, has reached 5000 ft. The company has carried out geophysical work in southern England. G. D. H.

252. Dutch Production Small. Anon. *Oil Gas J.*, 6.7.46, **45** (9), 59.—The Coevorden production is expected to be about 5600 brl/day. G. D. H.

253. Iran's Daily Average Output Shows Gain. Anon. *Oil Gas J.*, 22.6.46, **45** (7), 63.—Iran's crude production was 10,997,000 brl in January, and 10,472,000 brl in February 1946. The 1945 production was 123,873,000 brl, and the 1944 production 92,919,701 brl. G. D. H.

Transport and Storage.

254. List of Motor Ships on Order (over 1000 tons d.w.c.). Anon. *Motor Ship*, 1947, **27**, 382.—A list is given of the motor ships on order throughout the world. Details are given under the headings: owners; builders; tonnage d.w.c.; engine builders; type of machinery; b.h.p.; speed of ship in knots. I. G. B.

255. Welded Magnesium Tanks, I. R. J. Gross. *Airc. Prod.*, 1947, **9** (99), 28.—Deals with design considerations, comparison of materials, and the testing of large fuel tanks. The effect of light-weight fuel tanks on aircraft operational economy is stressed by the statement that every pound of structural weight saved in airframe for a passenger-carrying aircraft with a useful life of 2 years is worth £30 sterling. An analysis of weights, surface area, and form shows that the conventional aluminium alloy tank weights range between 1 and 1·4 lb/sq. ft of area whereas magnesium tanks range between 0·6 and 1 lb/sq. ft. I. G. B.

256. Recent Developments in Pipeline Technology. H. H. Anderson. *Oil Gas J.*, 16.11.46, **45** (28), 241.—A brief report on recent developments in pipeline technology is given.

The capacities of older lines were improved by looping lines and reducing pipe-resistance and stream viscosities. The customer service was improved by means such as running direct to refinery topping units and making advances in reducing contamination. Operating techniques were bettered by installing more automatic-stations and mobile pumping units, whilst in maintenance corrosion control and line reconditioning are among problems receiving attention. New construction methods and trends are also briefly reviewed. G. A. C.

257. Use of Corrosion Inhibitors in Products Pipelines. I. M. Parker. *Oil Gas J.*, 16.11.46, **45** (28), 255.—Internal corrosion in pipelines is associated with water and oxygen, a film of water adhering to the metal being necessary, whilst oxygen acts as an accelerator by reacting with ferrous hydroxide and removing hydrogen. The problem is to eliminate water, oxygen, or inhibit the reaction.

The function of an inhibitor is to repair the iron-oxide film which is continually being broken, with a non-permeable membrane. Inhibitors should be soluble in gasoline and slightly soluble in water, must not react with or alter the gasoline, and must possess an affinity for metals.

Mercaptobenzothiazole, sodium chromate, and sodium nitrite are successful inhibitors; and, for example, the latter acts by building a straight ferric-oxide film.

In general the inhibitor is injected continuously, the amount and concentration being altered to accommodate varying distances between pump stations. In addition an intensive scraping programme is carried out, which hastens the removal of old rust. All lines which have had an established inhibitor programme have reported good internal pipe conditions. G. A. C.

258. Use of Dehydration in Combating Internal Corrosion in Products Pipelines. H. K. Phipps. *Oil Gas J.*, 23.11.46, **45** (29), 67.—Interior corrosion in pipelines is due chiefly to the presence of water in the product being transported, which separates, and, in combination with free oxygen in solution in the product, causes rusting.

The dehydration process lowers the moisture content of the product to a small amount such as will remain in solution even when minimum line temperatures are met. Scrapers are not necessary with dehydration. The installation at Augusta, Kans. pump station consists of six drums 4 ft in diameter and 9 ft high, with cone bottoms. 3000 lb of 4–8 mesh activated alumina supported on a metal perforated plate is used as dehydrating agent. The product is pumped through 3 of the towers in parallel, towers being regenerated by passing superheated steam at 450° F through the bed until it has reached 380° F, then blown with refining gas, evacuated and then filled with natural gas. Regeneration takes place every 12 hours or on change of product, and requires about 5 hours. Throughput is 700 brl per hr, about 60% of the total water being removed. Costs will not exceed 50 cents per 1000 brl of throughput, and actual costs for the installation described were 41 cents per 1000 brl and complete prevention of interior corrosion is claimed. G. A. C.

259. Weight of Steel Tubing. W. L. Nelson. *Oil Gas J.*, 14.12.46, **45** (32), 113.—No. 123 in the Refiners Notebook Series lists the weight of steel tubing in lbs per ft length for tubes of various wall thicknesses and outside diameters.

The wall thicknesses are quoted in decimals and fractions of an inch. G. A. C.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

260. Tests at Cycling Project Demonstrate Possibilities of New Corrosion Inhibitor. W. H. Justice and E. N. Jones. *Oil Gas J.*, 9.11.46, **45** (27), 86. (*Paper presented at Quarterly Meeting of Corrosion Research Project Committee, N.G.R.A., held at Dallas, Oklahoma.*)—Severe corrosion of equipment used at the gas-condensate wells West Tuleta field, Bee County, Texas, lead to the trial of a corrosion inhibitor suggested by the Tetrolite Co. The new inhibitor, Kontol 115, developed during the war for the U.S. Navy, is a semi-polar organic reagent which forms an invisible adherent protective film on metal surfaces and is soluble in oil and does not react with magnesium or calcium salts. Details are given of the field, its production and the results of field tests carried out are described. By the injection of 1·75 qts/day when the production was 4,000,000 cu. ft/gas/day, the corrosion was reduced to 7% of the original rate at a cost of \$0·87/day or \$0·21 per 1,000,000 cu. ft of gas. The inhibitor exhibits a residual corrosion reduction for several days after injection is discontinued, no plugging or emulsion troubles were observed. The method of iron analysis used during the tests is described. W. H. C.

261. Bateman Field Cycling Operations More Than Doubled by New Plant Facilities. N. Williams. *Oil Gas J.*, 30.11 46, **45** (30), 72.—Cycling capacity in the Bateman Lake field has been increased from 30,000,000 cu. ft of gas to 70,000,000 cu. ft daily by installation of new equipment. The area unitized for cycling covers approximately 6100 acres.

Elevation is only from 5 to 7 ft above sea level, the marsh being entirely covered with water most of the year, and access is exclusively by canals.

The entire plant is supported on concrete piles, and includes depropanizer, reabsorbers, stills and distillate stripper, direct-fired fat-oil heaters, steam-raising plant, and other conventional equipment. Output totals from 73,000 to 75,000 gal daily. G. A. C.

262. Hollday Gasoline Plant Designed to Require Minimum Water Supply. H. W. Harts. *Oil Gas J.*, 23.11.46, **45** (29), 78.—Owing to the unsuitability of the water available 17 miles distant a direct-fired oil heater was installed instead of a steam-generating plant at a gasoline and re-pressure plant in Archer County, Texas. The

heater supplies all the heat required, including heat for rich oil to still, reboilers for the fractionating columns, and to the various buildings. Fin-tube air-coolers of the induced-draft type were fitted, and water was only necessary for engine-jacket make-up and for final cooling.

The plant processes 16,000,000 cu. ft of gas from 600 wells daily discharging it at 200 p.s.i.g., compresses 6,000,000 and 2,000,000 cu. ft per day of residue gas, to 800 and 1800 p.s.i.g. respectively, and extracts 60% of propane.

Wet gas is gathered from the fields, compressed to 200 p.s.i.g., cooled with the fin-type air coolers, final cooling being accomplished by open sections in a tower during hot months. Residue gas leaving the absorber-de-ethanizing column is repressured in an air cooled two-stage booster equipment. The rich oil is heated and the methane and ethane flashed off in the column; a conventional still and dephlegmator heating the fat oil, depropanizer overhead condensate being used for stripping instead of steam and still vapours being condensed by the fin-type and open-section coolers. All pumps are electrically driven except for a gasoline-engined fire pump. G. A. C.

263. Tube Diameter and Thickness—Refiner's Notebook No. 116. W. L. Nelson. *Oil Gas J.*, 26.10.46, **45** (25), 127.—Inside tube diameter is dependent on the liquid velocity that must be employed to avoid overheating and the pressure drop that can be tolerated. The approximate tube velocities based on volume at 60° F, are tabulated for 13 refinery units. The outside diameter and wall thickness of furnace tubes are discussed, and the approximate minimum wall thickness of three grades of pipe-still tubes of 4, 5, and 6 in outside diameter, are given for operating at 300, 600, and 900 p.s.i., at three different temperatures. A table shows the composition and comparative costs of 14 steels, their design strength (creep of 1% in 10,000 hr at 1000° F), and the losses by scaling and corrosion, in terms of the penetration by scaling and by sulphur, relative to carbon steel. W. H. C.

264. Creep Strength of Steels. 1% in 100,000 Hours. Refiner's Notebook No. 118. W. L. Nelson. *Oil Gas J.*, 9.11.46, **45** (27), 103.—A graph is given from which the creep strength of steels, p.s.i. 1% in 10,000 hr, may be obtained at temperatures from 900° to 1400° F for 16 steel alloys of given composition. W. H. C.

Distillation.

265. Design of a Pipe Still. W. L. Nelson. *Oil Gas J.*, 30.11.46, **45** (30), 95.—No. 121 in the *Refiner's Notebook* series describes the design of a pipe still; the required number of radiant and convection section tubes being determined for a given situation. Back numbers in the series are referred to and quoted. G. A. C.

266. Typical Fractionator Control Systems and General Principles in their Selection. J. J. Cicalese, J. A. Davies, P. J. Harrington, G. S. Houghland, A. J. Hutchinson, and T. J. Walsh. *Oil Gas J.*, 30.11.46, **45** (30), 90.—Four figures show a number of standard methods of control for fractionating columns. Included is instrumentation for production of constant vapour pressure bottoms, and for three cases of production of pure product overhead, the overhead being totally condensed. Where large quantities of material are being handled, or where the change in temperature is large with respect to the change at other points, careful selection of control position is necessary, and instruments should be selected and located so that speed of response is at least equal to rate of change with both feed and utilities. Lags due to inertia of large volumes of liquid passing through the system, or temperature, must be avoided by using instruments with the correct response, for example, too fast an instrument will produce over-control and set up cycling conditions. G. A. C.

Absorption and Adsorption.

267. Expanded Plant at West Pama Plays Dual Rôle. Extracts 80,000 gal of Gasoline Daily, Provides Extensive Repressuring Service. A. L. Foster. *Oil Gas J.*, 9.11.46, **45** (27), 72.—A description is given of the Skelly Oil Co's. Kingsmill natural gasoline

plant after its enlargement for the recovery of all practicable natural and liquefiable hydrocarbons from 500,000 cu. ft sour gas, 12,500,000 cu. ft of community gas, and 12,000,000 cu. ft sweet gas, per day, in connection with the West Pampa Gas-Repressuring Association programme at Panhandle, Texas. After stripping, the dry gas is distributed as follows: 5,000,000 cu. ft is passed to the various wells at 500 p.s.i. for repressuring, 3,000,000 cu. ft at 75 p.s.i. is used for field purposes, and 3,000,000 cu. ft for plant work, the remainder at *ca* 50 p.s.i. being sold for carbon black production. It is noted that the Panhandle field provides 75% of the American carbon-black production. W. H. C.

268. Evaluation of Absorber Operating Efficiency. E. G. Ragatz and J. A. Richardson. *Oil Gas J.*, 23.11.46, **45** (29), 89.—A technique for evaluating absorber performance has been developed based on analyses of operating characteristics of some 40 commercial columns ranging in pressure from 30 to 1800 p.s.i.g.

The conventional Souders and Brown chart has limitations, which the new straight-line chart should overcome.

The method utilizes simple data readily obtainable, eliminates personal judgment, provides an automatic check on the consistency of the test—indicated key component recoveries and predicts relative key component recoveries. There is no need to run an absorber on a precise quality of feed stock, accurate definition is possible and a simple number is used for final identification of the operating efficiency of the column. A number of charts illustrates the method. G. A. C.

269. Fat-Oil De-ethanization. A. M. Whistler. *Oil Gas J.*, 26.10.46, **45** (25), 105.—In the separation of gasoline components from natural gasoline by oil absorption, much of the unwanted methane and ethane hydrocarbons are also absorbed and their presence in the fat-oil causes trouble in the separation of the desirable components. A study of the limitations and capabilities of absorption plants is made in which a normal system containing a gasoline de-ethanizing column (Plant B) and a system containing a fat-oil de-ethanizing column (Plant A) are compared and described as to plant components and operation, and compared as to initial costs and operating expenses. The over-all propane recovery of both are shown and the nett returns are compared. The use of a fat-oil de-ethanizer in an absorption system is dependent upon several factors which may be divided into 3 main groups; (*a*) where from 50 to 90% propane, or more properly propylene, is recovered; (*b*) where propane can be readily marketed. Propane is still not worth expensive plants, oil rates being set by butane recovery; and (*c*) where propane is not marketable. The fat-oil de-ethanizer is not suitable for case (*a*) as too much propane is lost, neither does it fit case (*c*), on account of the extra cost of fuel for its operation. But its usefulness appears in case (*b*). A fat-oil de-ethanizer system costs less than a normal absorbing system, but its operating expenses are greater. Even so, for case (*b*), with amortization over 4 years, an average yearly saving of $40,000 would accrue. For case (*c*), it is shown that the gasoline—de-ethanizer, as in Plant B, can be eliminated, but the reabsorber stays in to hold the butanes, and the other plant components remain the same. This reduces the cost by $50,000, and, not having a fat-oil de-ethanizer, saves $5500 a year in extra fuel requirements. The fat-oil de-ethanizer is not suitable where the primary purpose is recovery of propane or propylene, for which a special plant is required, neither does it fit the case where a side-stream of propane is sufficient in quantity and quality to supply the market. Where oil rates are set by butane recovery and a good market for propane exists, the fat-oil de-ethanizer has excellent possibilities. W. H. C.

Cracking.

270. New Cat. Cracker Incorporates War-Developed Improvements. Anon. *Oil Gas J.*, 14.12.46, **45** (32), 80.—The latest catalytic cracking unit of the Texas Oil Co. which incorporates developments made during the war, was put into operation January 1946 at Lockport, Ill.

Features include a Cottrell precipitator for the final recovery of the catalyst from the flue gases, an A frame preheater and a 60,000,000 b.t.u. per hour design duty recycle catalyst cooler. Initial batch of catalyst consisted of spent material from two other units. The plant is expected to operate for one year before shut-down for inspection. G. A. C.

271. Delayed Coking Unit in Operation. Anon. *Chem. Eng News*, 1946, **24**, 2928.—The operation of the world's largest delayed coking unit at the Torrance, California, refinery of the General Petroleum Corporation, is resulting in over-all increased yields of motor gasoline and Diesel oil per brl feed, in an increase in O.N. of the gasoline, and decrease in less profitable fuel oil production. An important product is high-grade petroleum coke, amounting to over 200,000 tons per year, for the manufacture of electrodes for the aluminium and related industries. Reduced crude heated to 900° F is discharged into alloy-lined drums where it is allowed to coke. Only vapours are withdrawn from the drums, these undergoing fractionation into gas, gasoline, and gas oil. Water jets, at 1500 p.s.i., are used to remove the coke from the drums and wash it into a main pit, from which a specially designed pump transports the cleaned and sized coke to storage. L. B.

Polymerization.

272. Correlation of Operating Variables in the Polyform Process. J. H. Hirsch, P. Ostergaard, and W. C. Offutt. *Oil Gas J.*, 16.11.46, **45** (28), 225.—A generalized correlation has been prepared based on data from 139 pilot-plant runs on 17 charge stocks.

It is applicable to self-contained polyforming, and to polyforming with addition of outside C_3 and C_4 fractions up to 60% of naphtha charge. Charge stocks ranged from Rodessa naphtha to catalytic cracked naphtha. Yields of various products such as hydrogen, methane, ethane, *n*-pentane, and pentanes can be calculated from the correlation. Yields, throughputs, and properties of products are related to character of fresh charge, severity of treatment, extent of recovery, and recycling of C_3 and C_4 fractions, and operating pressure.

A sample yield calculation sheet is given. G. A. C.

273. Naphtha Polyforming. W. C. Offutt, P. Ostergaard, M. C. Fogle, and H. Beuther. *Oil Gas J.*, 16.11.46, **45** (28), 180.—The Polyform process for production of motor gasoline with 75–80 A.S.T.M. and 84–93 Research octane numbers without T.E.L. is described.

The naphtha charge, enriched with C_3 and part of the C_4 fractions from the stabilizer overhead vapours, in the high-pressure absorber, passes to the heater and is there raised to 1025–1125° F at 1000–2000 p.s.i.g. then quenched and flashed in the fractionator at 300–400 p.s.i.g.

Overheads go to the stabilizer from the bottom of which is taken the Polyform gasoline.

Yields depend on charge, furnace pressure and temperature, and reaction time, increase of temperature and time resulting in decreased yield but increased antiknock quality. Figures show gasoline yields *v.* A.S.T.M. octane number for various naphthas, effect of pressure and distillate yield *v.* octane improvement when polyforming at 1500 p.s.i. When producing for maximum yield of butane–butene, the Polyform unit is operated as a depropanizer, all the required product being removed with the gasoline, yield increasing with cracking severity up to a point, when higher severities result in a decrease of yield The lead response for Polyform distillate is summarized in a chart relating lead response with A.S.T.M. octane number of the distillate and the 50% point of the naphtha charge. G. A. C.

Alkylation.

274. Aviation Fuel Properties Varied by Alkylate—Hydropolymer Content. H. W. Field and D. W. Gould. *Oil Gas J.*, 16.11.46, **45** (28), 215.—Comparison of the analysis of a sulphuric acid alkylate with that of a hydrogenated codimer from a phosphoric acid catalysed polymerization plant explains the difference in blending characteristics of the two materials. A table gives operating conditions and inspections for Project 6 hydrocodímers; these analyses show that HF alkylation is a "purer" alkylâtion in that the production of 2 : 2 : 4-trimethylpentane is more predominant than in the sulphuric acid process.

A table also shows the effect of introducing full boiling range pentenes into an

alkylation plant as an additional olefin feed, a drop in alkylate quality particularly in the F-4 value resulting. The data obtained was used for extensive alkylation of light pentenes in many sulphuric acid alkylation plants.

Highly branched-chain olefins from the sulphuric acid polymerization units were charged to sulphuric acid alkylation units with resultant depolymerization of the feed, alkylation taking place in a normal manner.

Hydropolymer operations were studied, it being found that material of lower octane value was produced by the chamber-type plant. When reactor temperatures were raised, the product was degraded in quality. Analysis of codimer-feed variations showed that a high-*iso*butene feed produced a hydrogenated product with a substantially higher F-3 but lower F-4 octane value than normal, due to the production of an abnormally higher proportion of 2 : 2 : 4-trimethylpentane. G. A. C.

Chemical and Physical Refining.

275. Recent Advances in Perco Catalytic Desulphurization of Refinery Gasolines. G. M. Brooner and M. W. Conn. *Oil Gas J.*, 26.10.46, **45** (25), 96.—Two methods are discussed for improving gasolines to meet the increasing competition with respect to octane improvement. These are the small catalytic cracking units, now available, and the catalytic desulphurization processes. The former is shown to be usually beyond the sound economic reach of the average small refiner, and is justifiable primarily on increased yields of gasoline and secondly on over-all refinery octane-number appreciation. The Perco catalytic desulphurization processes, however, may be operated for the improvement of products from existing plants with a minimum of additional capital investment and operating costs. The process is outlined and commercial plant data are given and discussed from operations on the following :—(*a*) Straight-run gasolines, from various sources, in five different capacity plants. The sulphur contents varied from 0·056% to 0·193%, and were reduced to from 0·005% to 0·021% and A.S.T.M. octane values were increased by 1·8 to 3·9, clear, and with 3 cc T.E.L. by 5·0 to 8·1 ; (*b*) A blend of S–R and cracked gasoline from a Michigan crude ; (*c*) Semi-commercial desulphurization and thermal reforming of West Texas naphthas, in which the naphthas after catalytic desulphurization were thermally reformed at three destructive levels ; (*d*) Tests conducted on a cracked gasoline of 490 E.P. and the same refractionated to 375°, 350°, and 325° end points, before and after catalytic desulphurization over bauxite at 750° F, show that desulphurization of 400 E.P. stock gave a higher octane increase than the lowest E.P. cut, which also resulted in a 33% loss on the original gasoline. This being equivalent to 51% more barrel octane numbers at the 3 ml T.E.L. level than reduction of the raw charge to the 325 E.P. The Perco Catalytic Reforming Process, a modification of the Perco Cycloversion Process, is described. It is applicable to motor-fuel boiling-range stocks and naphthas and, in some cases, to heavy naphthas competitive with thermal reforming. The normal benefits derived from catalytic desulphurization *per se* are obtained together with an appreciable increase in clear octane rating due to some additional cracking or reforming as shown by the fixed gases and increasing hydrocarbon destruction with increasing severity of operation. The results are shown in 9 tables of operations on various straight-run, cracked and blends, of gasolines, naphthas, etc., at different destructive levels. Catalyst regeneration is discussed. The flexibility of the processes is such that it permits a wide variety of operations on selected fractions or on total refinery gasoline, as may be desired or dictated by economics and finished product sales. W. H. C.

PRODUCTS.

Chemistry and Physics.

276. On a New Polynuclear Hydrocarbon, 2 : 3 : 1′ : 8′-Dinaphthalene. H. Moureu, P. Chovin, and G. Rivoal. *Comptes Rend.*, 1946, **223**, 951.—Condensation of *o*-phenylene diacetonitrile with acenaphthaquinone gave as product the nitrile-amide of 2 : 3 : 1′ : 8′-dinaphthalene-1 : 4-dicarboxylic acid, which after hydrolysis to the

corresponding di-amide and then to the dicarboxylic acid with simultaneous decarboxylation yielded the hitherto unknown polynuclear aromatic hydrocarbon 2 : 3 : 1′ : 8′-dinaphthalene as pale yellow crystals, m. pt. 216° C, fluorescing yellow-green and blue in ultra-violet light in the solid form and in dilute solution respectively, giving a yellow-green colour in warm concentrated sulphuric acid, and forming an unstable picrate as red needles, m. pt. 160° C. With phenanthraquinone the same series of reactions yielded 1 : 2 : 3 : 4-dibenzanthracene, and can be applied to the synthesis of other polynuclear hydrocarbons. G. H. B.

277. A Relation Between Internuclear Distances and Potential Barriers of Methyl Groups. F. A. French and R. S. Rasmussen. *J. Chem. Phys.*, 1946, **14**, 389.—An empirical relation between contributions of various groups to the potential barriers of methyl groups and the minimum distance of approach of atoms in these groups to the methyl group is given. The application of this relation to the estimation of barrier values for other molecules is demonstrated. J. T.

278. Behaviour of Macromolecules in Inhomogeneous Flow. H. A. Kramers. *J. Chem. Phys.*, 1946, **14**, 415.—In connection with Kuhn's skein theory, J. J. Hermans (*Physica*, 1943, **10**, 777) has developed a method to describe the properties of dilute solutions of highly polymerized molecules and the influence of these molecules on viscosity and double refraction. In this method it is shown that behaviour of the molecule is characterized by the diffusion of the end points and that the contributions of a molecule to the viscosity and double refraction of solution is proportional to the square of degree of polymerization in conformity with the experiments. In this article a more detailed theory which can also be extended to macromolecules having branching points and rings, is developed. J. T.

279. Conductometric Investigation of Electrolytic Solutions in Hydrocarbons. A. Gemant. *J. Chem. Phys.*, 1946, **14**, 424.—Conductometric experiments were made on a number of electrolytic solutions in xylene and of a hydrocarbon oil both of which had conductivities in the range 10^{-12} to 10^{-11} mho/cm at room temperature. The electrolytes used consisted of an amine and an organic acidic material. In order to obtain high conductivities at relatively low concentrations of electrolytes, it was generally found necessary to use a three component system composed of an amine, an aliphatic acid, and a phenol. The effect of the phenol is shown to be due only partly to the increase of dielectric constant, the chief process is probably a specific one. On the basis of the theory that the mechanism may be explained by the formation of an addition compound which dissociates into ions, the experimental data were subsequently subjected to an analysis. It appears that five or more single molecules usually combine to form a compound and that the concentration of this compound is small in comparison with the total solute present. In connection with the deterioration of insulating oils it is shown the high conductivities of such oils even when certain colloidal constituents are present, are ultimately caused by formation of electrolytic ions of the type investigated. J. T.

280. Accommodation Coefficients for Heat Conduction Between Gas and Bright Platinum, for Nine Gases Between 80° K (or Their Boiling Points) and 380° K. E. R. Grilly, W. J. Taylor, and H. L. Johnston. *J. Chem. Phys.*, 1946, **14**, 435.—Accommodation coefficients between 80° K and 380° K towards bright platinum of a hot wire cell have been calculated for air, oxygen, nitric oxide, carbon monoxide, carbon dioxide, nitrous oxide, methane, hydrogen, and helium. The calculations are based on the slopes of the reciprocal plots of experimental "apparent" conductivity *versus* pressure for various pressures used in the cell. The results are tabulated and are compared with those of other investigators. The accommodation coefficient for hydrogen rises with descending temperature and tends towards unity. With gases other than hydrogen the results indicate a sharp decrease in accommodation coefficients at temperatures between the room temperature and that of the liquid air. The accommodation coefficients derived from the reciprocal conductivity *versus* reciprocal pressure slightly differ from accommodation coefficients obtained by Knudsen and are referred to as "Maxwell–Knudsen" coefficients. A few equations are derived expressing the relationship between the reciprocal slopes, the "temperature jump" constants, and the Maxwell–Knudsen coefficients. J. T.

281. Statistical Mechanics of Multimolecular Adsorption. II. Localized and Mobile Adsorption and Absorption. T. L. Hill. *J. Chem. Phys.*, 1946, **14**, 441.—The transition from localized to mobile adsorption (in the first adsorbed layer) is shown to take place at low temperatures for potential barriers of about 1000 cal./mole or less so that localized physical adsorption should be rare at the temperatures usually employed in adsorption experiments. Since the BET (and Langmuir) isotherm actually assumes localized adsorption, a new approximate isotherm equation is derived on the basis of a mobile first layer obeying a two-dimensional Van der Waals' equation. This isotherm is in semiquantitative agreement with the two-dimensional phase changes observed by Jura and co-workers, and by earlier workers, at very low pressures. A brief mention is made of the localized-mobile transition in the absorption of hydrogen by metals. The relationships between (1) the two-dimensional equation of state of a monolayer; (2) the adsorption isotherm of the monolayer; and (3) the ordinary three-dimensional equation of state of the gas being adsorbed are discussed in detail.
J. T.

282. Time-Dependence of Boundary Tension of Solutions. I. The Rôle of Diffusion in Time-Effects. A. F. H. Ward and L. Tordi. *J. Chem. Phys.*, 1946, **14**, 453.—The change in surface tension of solutions when the change is over within a few seconds or less has been explained on the basis of diffusion. A rigorous mathematical analysis of the part that diffusion might play in such time-effects is given and the limitations of other diffusion theories in this connection have been discussed. A general theory of diffusion to the surface which allows for back-diffusion and makes no special assumption of a physical nature is derived and recent data on time-effects of short duration are analysed. The conclusion reached is that even in cases where the variation of the surface tension is over in less than a second the rate-determining process is not diffusion. Even for these very rapid changes one is inclined to assume the existence of an activation barrier which determines the rate of adsorption.
J. T.

283. Analysis of Alkylates and Hydrocodimers. A. R. Glasgow, A. J. Streiff, C. B. Willingham, and F. D. Rossini. *Oil Gas J.*, 16.11.46, **45** (28), 236.—This is an abstract of work by the A.P.I. Research Project 6 on the analyses, with respect to individual hydrocarbon components, of 28 different alkylates and hydrocodimers; including 15 sulphuric acid alkylates, 5 HF alkylates and 8 hydrocodimers from various sources. A table shows the percentages of hexanes, heptanes, octanes, nonanes, and higher paraffins found in the samples.
G. A. C.

284. Purification and Sealing " in Vacuum " of National Bureau of Standards Standard Samples of Hydrocarbons. B. J. Mair, D. J. Termini, C. B. Willingham, and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, 1946, **37** (4), 229.—The procedure and apparatus used is described for the purification and sealing " in vacuum " of 19 National Bureau of Standards Standard samples of hydrocarbons, including 9 paraffins, 3 *cyclo*-paraffins, and 7 alkylbenzenes.
T. M. B. M.

285. Heats, Equilibrium Constants, and Free Energies of Formation of the Alkylbenzenes. W. J. Taylor, D. D. Wagman, M. G. Williams, K. S. Pitzer, and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, 1946, **37** (2), 95.—Continuing the work of A.P.I. Project 44 at the National Bureau of Standards, values for benzene, toluene, ethylbenzene, the three xylenes, normal and *iso*propylbenzene, the three methylethylbenzenes, the three trimethylbenzenes, and the higher normal alkyl-benzenes are presented for the following thermodynamic properties for the gaseous state to 1500° K: The heat content function $(H^\circ - H_0^\circ)/T$; the free energy function $(F^\circ - H_0^\circ)/T$; the entropy, S°; the heat content, $H^\circ - H_0^\circ$ the heat capacity, C_p°; the heat of formation from the elements, ΔHf°; the free energy of formation from the elements ΔFf°; and the logarithm of the equilibrium constant of formation from the elements, $\log_{10} Kf$.

The equilibrium constants and concentrations for the isomerization of the four C_9H_{10}-alkylbenzenes and for the eight C_9H_{12}-alkylbenzenes are given in tabular and graphical form as a function of the temperature to 1500° K. Equilibrium constants are also given in tabular and graphical form for some reactions involving alkylation (addition of olefin to benzene to form alkylbenzene), cyclization (conversion of paraffin

to alkylbenzene plus hydrogen), and trimerization (of acetylene to form benzene and of methylacetylene to form 1 : 3 : 5-trimethylbenzene). T. M. B. M.

286. Purification, Purity, and Freezing Points of 31 Hydrocarbons of the A.P.I.—N.B.S. Series. A. R. Glasgow, Jr., E. T. Murphy, C. B. Willingham, and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, 1946, **37** (2), 141.—The purification and determination of freezing points and purity of 31 hydrocarbons are described. They include 2 pentanes, 5 hexanes, 2 heptanes, 1 octane, 3 alkylcyclopentanes, 3 alkylcyclohexanes, and 15 alkylbenzenes. T. M. B. M.

Analysis and Testing.

287. Infra-Red Absorption Cell for Liquids. N. D. Coggeshall. *Rev. sci. Instrum*, 1946, **17**, 343.—The cell consists of two rock-salt plates separated by a 0·006 in thick amalgamated lead shim cut into annular form. The plates are held together by two pairs of metal strips bolted through the rock-salt and provided with a washer of amalgamated lead. Each pair of strips is fitted with a needle valve, of which one (T) is machined to a tolerance of 0·1 to 0·4 thousandths of an inch, and the other (L) to a large tolerance. To fill the cell liquid is placed in the top opening and forced inside by movement of T, which acts as a piston. Cleaning is performed by introducing liquid at L, and applying a vacuum at T. The cell is of rugged construction, and will hold volatile liquids for several weeks. H. C. E.

288. Electronic Detonation Meter for Motor Fuel Anti-Knock Rating. D. R. de Boisblanc and H. M. Trimble. *Oil Gas J.*, 9.11.46, **45** (27), 57.—An instrument called the Phillips electronic detonation meter which has been developed as a substitute of the bouncing pin in A.S.T.M. and C.R.C. knock-rating tests, is described.

Basically it consists of an electro-magnetic pick-up unit in the engine cylinder coupled to a circuit of three amplifiers and a vacuum tube voltmeter. The pick-up converts cylinder pressure variations into voltages which are then fed into the amplifying circuit. The only operating controls are gain controls on two of the amplifiers. One controls the sensitivity, and the other the "spread" of the readings recorded on the voltmeter. Data and graphs are presented showing comparative results obtained with this meter and the bouncing pin. It is suggested that the Phillips meter may possibly be used over the entire range of the A.S.T.M. method with one setting, whereas at present it is customary to set the bouncing pin near the octane level of the fuels to be tested. J. N.

Gas.

289. Conversion of Natural Gas to Liquid Fuels. R. C. Allen. *Oil Gas J.*, 9.11.46, **45** (27), 79. (*Slightly abridged version of a paper presented at the October meeting of the California Natural Gas Association.*)—The Fischer–Tropsch process as operated in Germany is outlined, and the approximate costs of manufacturing synthesis gas from natural gas and from coal are compared. A process is described for the making of hydrogen from natural gas which has been in commercial use for some years, and a modification of this by which synthesis gas having the correct H_2 : CO ratio of 2 : 1 can be made is described, but both are expensive. An alternative process is detailed, employing low cost oxygen, derived from air, by a war developed process which is outlined. This produces synthesis gas in the ratios required at a very low cost. The reaction may be represented as follows: $CH_4 + \frac{1}{2}O_2 = CO + 2H_2$. In the synthesis of hydrocarbons from natural gas, an advance over the German technique has been made by the use of a fluid catalyst which gives greater surface area for reaction, and allows space velocities to be increased from *ca* 100–250 to between 2000 and 3000 vol. of feed gases, to 1 vol. of catalyst per hour, and also simplifies heat removal from the exothermic reaction (7000 B.Th.U./lb of product formed) and has several other advantages which are discussed. A flow diagram of the process for motor fuel manufacture shows the various units covering the making of synthesis gas and the hydrocarbon synthesis products. Operation is briefly described, the synthesis gas passes

out of its producer at 2100° F and is cooled to 600° F by water coils, giving some process steam, and then passes to the reactor which contains the powdered iron catalyst and water coils which aid temperature control by removing the heat evolved in the reaction and provides great quantities of steam. The total steam being nearly enough for the process requirements. The products from 80,000,000 cu. ft/day amount to about 4100 brl gasoline, 900 brl diesel fuel, and 360 brl oxygenated chemicals. The gasoline after simple bauxite treatment has an octane value of *ca* 75–80, and the diesel fuel a cetane number higher than 50. The significance of the improvements is shown by the following :—

Comparative costs for production of Liquid fuels.	Investment cost per brl day.	Cost per gallon, including 10% depreciation.
European processes using coal . . .	$7600	(*a*) 19·2 cents
European processes using natural gas .	$4750	(*b*) 8·8 ,,
American processes using natural gas .	$2000–2500	(*b*) 5·0 ,, (Approx.)

(*a*) Coal at $2.75/ton. (*b*) Natural gas at 5 cents/1,000,000 cu. ft.

W. H. C.

Engine Fuels.

290. Comparison of Tetraethyl Lead and Organic Nitrogen Anti-detonants. Elevation of the Octane No. by the Addition of Both. G. Roberti, C. Minervini, E. Pipparelli, and E. Semmola. *Riv. Ital. Petrol.*, 1946, **161**, 10.—Interest in the possibility of raising the O.N. of leaded fuels by the addition of small amounts of aromatic amines lead the authors to investigate the stability of such mixtures at low temperatures. Data on the separation temperatures for various amine concentrations are given and the effect of a third constituent on these temperatures was studied. The addition of *n*-butyl alcohol in approximately 1% concentration is recommended for increasing the low temperature stability of gasoline-amine blends. J. F. T.

Lubricants.

291. Heavy Duty Engine Oil Testing. N. D. Athey. *Gas Oil Pwr*, 1946, **41**, 417.—There is no accepted laboratory procedure for predicting the performance of lubricating oils in engines. Engine tests have been devised to establish the behaviour of an oil regarding its resistance to ring sticking, ring scuffing, sludging, varnish formation, and bearing corrosion. The conditions in engines favourable to these manifestations are described.

In the U.S.A. ring sticking and scuffing are evaluated with a 5½-in. bore × 8-in. stroke single cylinder Caterpillar diesel operating at 1000 r.p.m. in a 480 hr test, changing the oil every 120 hours. A similar engine, used for evaluation of these properties in an accelerated test, is so designed that the combustion flame impinges directly on the anti-thrust side of the liner. The measurement of bearing corrosion utilizes a four cylinder 4½-in. × 5½-in Caterpillar engine at 37 b.h.p. for 120 hr; and in an accelerated test a six-cylinder Chevrolet engine (petrol) is run at high crankcase temperature. Ring sticking, bearing corrosion, and oxidation resistance are determined in a G.M. two-stroke diesel running at 26 b.h.p. per cylinder for 500 hr.

The engine criteria by which the oils are judged are briefly indicated. H. C. E.

292. Secrets of German Lubricating Oil Technology Revealed. Part V. C. I. Kelly. *Petrol. Times*, 31.8.46, **50** (1281), 903.—The shortage of natural oils for the manufacture of fatty acids used in making soaps for greases, was responsible for the development of processes in which tallow, synthetic fatty acids, and Montan waxes (also known as I.G. waxes) and derivatives were used.

Olefinic lubricating oils from the aluminium trichloride polymerization of simpler olefines were put through the O.X.O. process and atmospheric oxidation of the result-

ing aldehydes gave carboxylic acids of which the soaps were oil soluble and convertible into greases. Synthetic fatty acids were also obtained from other oxidation processes.

A new grease was also derived: it consisted of a silica gel, actually an aerogel, and an oil which had to be free from polar bodies and low in aromatics.

The manufacturing methods at six of the German grease plants are reviewed, and the general test methods for German greases are discussed. The principal test methods for routine control purposes were those commonly used to measure: (1) the drop-point by the Ubbelohde unit; (2) the ash content; (3) the saponification value; and (4) the acid or alkali value. Other German devised tests were: (5) consistency; (6) water resistance; (7) heat resistance, syneresis or bleeding test; (8) corrosion stability; (9) cold behaviour; and (10) mechanical grease test: these are described in some detail. R. B. S.

Derived Chemical Products.

293. Petroleum Provides New Hydrocarbons for the Chemical Industry. C. C. Crawford. *Chem. Ind.*, Sept. 1946, **59** (3), 469.—The quantity of synthetic organical chemicals produced in the U.S. from petroleum has grown from 4080 lbs in 1939 to over 15,000 in 1944. For example, *cyclo*hexane of over 86% purity can be made; contaminants being removed by fractionation, or by a process involving isomerization of hexane-methyl*cyclo*pentane. Ortho-xylene of high purity is obtained by perfection of the Hydroforming Process and by refined distillation practices, and 99% normal heptane results from the use of fractionating equipment of very high efficiency, as is also toluene. Di*iso*propyl (2 : 3-dimethyl butane) is produced by alkylation of ethylene with *iso*-butane. Odourless naphthas for use in paints, varnishes, dry-cleaning, and insecticides have been produced without the aid of sulphuric acid, and precipitation naphthas of low solvent powers are in demand. Hydrocarbons with few exceptions are cheap, and tables give comparative prices of chemical raw materials obtainable from petroleum and other sources. Low costs are due to production of enormous quantities of by-product which is consumed by the gasoline market. The number of high boiling hydrocarbons available in high purity from petroleum is limited as purity decreases with increase of carbon content; and transportation charges of 5 cents per gal of gasoline from the natural gas and oil reserves of the South West or Far West to the chemical market in the East are also a factor. It is anticipated that there will be increased production of paraffins and olefins of high purity and of certain aromatic compounds. G. A. C.

294. Shell Chemicals Announces Plans for One of the Largest Chemical Plants in the World, Using Materials From Crude Petroleum Gases. Anon. *Chem. Eng. News*, 1946, **24**, 2926.—Starting in 1941 at Houston, Texas, with the first commercial plant for the manufacture of butadiene, the Shell Chemical Corporation expanded production to include *iso*propyl alcohol and acetone. Since the end of the war, attention has been directed to the manufacture of allyl chloride and related chemicals, used for a new type of plastic for decorative panels. These facilities are to be extended. In addition the manufacture of a new soil fumigant known as D-D, toxic to soil-borne pests attacking tomatoes, beans, and potatoes, as well as nematodes and its relatives, the wireworm and centipede, is to be undertaken. The project, involving the expenditure of $25,000,000 is expected to be completed in 2 years. L. B.

Miscellaneous Products.

295. Research Leading to Commercial Butadiene Synthetic Rubber. W. L. Semon. *Chem. Eng. News*, 1946, **24**, 2900.—The paper represents the Charles Goodyear Memorial Lecture delivered to the A.C.S. Division of Rubber Chemistry to commemorate the 100th anniversary of the vulcanization of rubber. The structure of rubber-like compounds and the principles underlying the commercial production of synthetic rubber are considered. Reference is made to the effect of butadiene purity and the influence of the type and amount of co-monomer (styrene, acrylate, methacrylate) on the quality of the product. The high degree of purity of the water used

in the emulsion polymerization process is emphasized. The functions of the emulsifying, solubilizing, and protective agents employed in the latter method of operation are discussed, and mention is also made of the use of cationic salts for orientating the monomer; modifiers, such as the higher mercaptans or bis-xanthogens for controlling chain length; the use of peroxides and persulphates or perborates, as initiators for the low and high temperature processes respectively; and finally, the use of α-amino acids or complex heavy metal salts as reaction accelerators. The effect of reaction time and temperature, the optimum degree of conversion, as well as the influence of the composition of the reaction mixture on the course of the reaction, are also described. The need to exclude interference as far as possible, by inhibitors picked up from the atmosphere, water or pipelines, is stressed. Details are given of process of latex formation and treatment, and methods of coagulating and purifying the rubber. The paper ends with a note on the uses and future of synthetic rubber. A comprehensive bibliography is appended. L. B.

Engines and Automotive Equipment.

296. Vapour Lock and Pump Selection in Aircraft Fuel Systems. R. S. Ames. *Aeronautical Engng Review*, Nov. 1946, **5** (11), 22.—The conditions of airplane operation under which vapour lock will occur can be predicted with fair accuracy. The failure can be traced to the point in the fuel system where the absolute pressure is lowest and this is normally within the positive displacement pump.

A practical example—the transfer system of the Goodyear F2G—is considered, and the contributions to system failure of hydraulic head, pressure drop due to flow, and pump losses are evaluated. It was found that test results confirmed the prediction of altitude vapour lock failures.

The analysis emphasizes the rôle of the pump and the importance of its characteristic curve. By studying the characteristic curves of pumps, it can be seen that larger positive displacement pumps and line boosters will not normally provide a satisfactory remedy for a defective fuel system. The centrifugal booster, with its low inlet loss, is a more effective solution. I. G. B.

297. Aircraft Ejector Performance. F. A. McClintock and J. Hall Hood. *J. Aeronautical Sciences*, Nov. 1946, **13** (11), 559.—This paper presents the results of work on the ejector problem carried out by the Research Department, United Aircraft Corporation, over the past few years. Equations are developed which, with the aid of empirical coefficients, enable one to estimate the performance of steady flow ejectors pumping a fluid across a small pressure rise or drop. Experimental data are presented which support the theory and provide information on some variables not covered by the theoretical treatment. An analogy between steady and intermittent flow is presented which makes it possible to estimate the performance of ejectors used in cooling aircraft engines. A method of applying the results to the design of ejectors is suggested.

The principal uses for an ejector in aircraft engine installations appear to be in those cases in which cooling would otherwise have to be obtained by the use of a fan or stalled cowl flaps, or in which the exhaust thrust could not otherwise be used because of flame, noise, or temperature. The results indicate that little gain in thrust can be obtained in an installation in which there is a pressure drop through the ejector so that pumping is not necessary. I. G. B.

298. De-Icing Today. J. K. Hardy. *Flight*, 1946, **50**, 673.—It is stressed that of all methods of de-icing the thermal method has been proved practicable and reliable in operation. Indications are given of the conditions under which ice is formed and discussion given on the various methods of dispersion of the ice. I. G. B.

299. Development of Supermarine Spitfire and Seafire Mark by Mark. Anon. *Aeroplane*, 1946, **71**, 746.—Details are given of the engine installation under the titles, mark, engine, airscrew, air intake, exhaust manifold, radiator type and thermal area, intercoolant radiator, oil cooler and area. I. G. B.

300. Twin Jet A.W. 52. Anon. *Flight*, 1946, **50**, 672.—A description is given of this aircraft, powered by two Rolls-Royce Nene turbo jets of 5000 lbs thrust each at take-off. The aircraft possesses many interesting features including the thermal de-icing system. Provision is made for heating in the wing by by-passing hot gases from the jet pipes. I. G. B.

301. Power Installations. F. M. Owner. *Flight*, 1946, **50**, 655.—Article (continued) outlines auxiliary services, general trend of development, airscrew turbines, jet turbine engines, and the detailed problems associated with turbine engines including turbine materials, compressors, combustion and fuel injection, de-icing, reduction gears, bearings, seals, lubricants, and airscrew control. I. G. B.

302. Power Installations. F. M. Owner. *Flight*, 1946, **50**, 1980.—Classifies future aircraft requirements with possible propulsion arrangements. I. G. B.

303. American Newcomer. Anon. *Flight*, 1946, **50**, 616.—Details given of the new 125-h.p. air-cooled Cameron CW-I-El engine. It is a 4-cylinder, in-line unit running at 2500 r.p.m.

Bore	4·75 in
Stroke	4·25 in
C.R.	6·4 : 1
Weight	200 lb.
Cruising power at 2200 r.p.m.	110 b.h.p.

The lubrication system is of the dry-sump type. A Stromberg model PS 5 injection carburettor is fitted and dual ignition is provided by two coils. I. G. B.

304. Designers Face the Future. Anon. *Aeroplane*, 1946, **71**, 653.—Four papers dealing with different aspects of the engineering problems facing designers of future aircraft were read before the Royal Aeronautical Society on November 14, 1946. F. M. Owner dealt with Power Installations, A. E. Russell with Large Airframes, C. P. T. Lipscomb with Flying Types, and G. H. Lee with Tailless Design. The discussion following is reported at some length. I. G. B.

305. Paris Aero Show. Anon. *Flight*, 1946, **50**, 594.—Description of aircraft types and aircraft engines is continued from page 569 (see Abstract No. 160). Photographs of engines and aircraft are included together with sketches of the interesting features of design. British engines, reciprocating and gas turbine, are described at some length.

An excellent diagrammatic section of the Rateau A 64 turbo-jet is made, giving details of mass flow temperature at various points of the cycle. Details are also given of a new light aircraft engine; 60 h.p. Georges Aveseng horizontally-opposed diesel. I. G. B.

306. Technical Aspects of the Paris Show. Anon. *Aeroplane*, 1946, **71**, 658.—Interesting features in this issue include a photograph of French full-scale wing test equipment. Loads are evenly distributed to the wing surfaces and it is distinctive in using the reverse of our loading system. Numerous photographs illustrate the products on show, whilst a list of foreign aero engines describes country, manufacturer, name or source, number of cylinders, type of cooling, superchargers, output, and weight. I. G. B.

307. The Regulation of the Power of Supercharged Engines. P. Ferretti. *Ricerca Scientifica e Reconstruzione*, 1946, **16**, 36.—A theoretical dissertation on the supercharged diesel engine in which the compressor is operated from a turbine in the exhaust line. The author considers the behaviour of the system under starting conditions and also under conditions of varying load. It is pointed out that in the latter case the most favourable conditions for combustion are maintained by the automatic regulation of the boost pressure. Although constant air intake temperature is desirable, the effect of variations in this temperature are discussed. J. F. T.

308. Cold Starting (of Diesel Engines). E. J. H. Bentz. *Gas Oil Pwr*, 1946, **41**, 395.—Troubles in starting occur at temperatures below 25° F. Dopes can be added to the fuel (1 : 1 di-ethyl ether and diesel fuel permits starting at −3° F) but many dopes are either unstable or corrosive to the engine. Alternatively heat can be applied to the intake air, either electrically or as a flame in the inlet manifold, sufficiently small to leave enough air for the engine to fire. The best method is to raise the entire engine temperature above the difficult starting temperatures. H. C. E.

309. Combustion Studies of the Diesel Engine. E. W. Landen. *Gas Oil Pwr*, 1946, **41**, 422.—Changes in refining procedure have produced fuels with cetane numbers below 40, and fuels which have low pour-point but inferior auto-ignition qualities. Fuels representing extremes of cetane number and distillation range have been tested in single cylinder liquid-cooled engines : (*a*) of the precombustion type with pressure pick-up outlets and observation windows, and (*b*) of direct injection type with interchangeable pistons giving ratios of 15 and 12 to 1.

Results are : (1) Cetane number is a straight line function of paraffinic content ; (2) Specific fuel consumption is almost a straight line function of distillation range ; (3) Fuel of high cetane number produces a combustion flame of long duration ; (4) Exhaust smoke is a function of b.m.p. ; (5) Ignition delay is greater in fuels of high distillation range.

It is also suggested that : (1) Pre-flame reaction is related to cetane number ; (2) Flame duration can be measured by emission spectroscopy ; (3) Absorption spectra indicate chemiluminescence and radiations from incandescent particles. Although cetane number is not ideal for rating fuels no better method has been found. Diesel engine operation can be improved by the use of extremely high cetane fuel, which, however, requires the development of a special engine. H. C. E.

310. Cold Starting of Diesel Engines. P. H. Schweitzer. *Diesel Pwr and Diesel Transportation*, 1946, **24**, 1190.—As the result of tests carried out by Pennsylvania State College in 1941 on a C.F.R. engine, it is concluded, and since confirmed, by other investigators, that the most effective method of cold starting diesel engines is by the introduction of diethyl ether into the air intake, and that starting without additional heat can be obtained at 0° F and much lower with additional heat.

Details of the engine test procedure for determining the critical starting compression ratio are given and various experiments described. These experiments showed that hydrogen peroxide did not improve starting even at 30% concentration in water, neither was benzol peroxide effective in this respect. Cetane vapour alone improved the critical compression ratio by only 1·5 points ; vapour from a low quality fuel (31 Cetane No.) was more effective in improving starting than that from high quality fuel (56 Cetane No.). The greatest improvement was obtained from the vapour from the most volatile fuel, the higher cetane number having only a secondary effect to volatility.

Similar observations were made from tests on high volatility hydrocarbons from which it was concluded that the qualifications of a good starting fluid were high volatility and that if the boiling point of the fluid was not more than, say 200° F the cetane number with the lowest latent heat was the deciding factor. C. D. B.

311. German Diesel Engine Development. H. A. Schade. *Motor Ship*, 1946, **27**, 329.—Deals with structural and power aspects of German war-time naval programme. Reference is made to the following engines :—

(1) M.A.N. 4-cycle, single-acting model MV 40/46 supercharged by a Büchi turbo-blower to give 145 lb/sq. in b.m.e.p.
(2) 2-cycle, double-acting model Z 32/44.
(3) Daimler-Benz Model MB 511, 4-cycle supercharged giving 150 lb/sq. in b.m.e.p.
(4) Development engines including a 2-cycle, sleeve-valve engine.
(5) Dentz 16-cylinder, horizontally opposed-piston type.
(6) Junkers Jumo 205 opposed-piston aircraft diesel engine.
(7) Development of " closed-cycle " diesel operation. I. G. B.

312. History of the Opposed Piston Marine Oil Engine. W. Ker Wilson. *Trans. Inst. Mar. Engrs*, 1946, **58**, 189; *Motor Ship*, 1946, **27**, 360; *Motor Ship*, 1947, **28**, 418.—The development of the opposed piston oil engine in this century is traced by the author in this article.

Some of the early work carried out on direct fuel injection systems is described, with particular reference to its adaption in the Doxford single-cylinder experimental engine in 1916. It was not, however, until 1930, that there was any general trend towards direct fuel injection.

Brief descriptions, illustrations, and data are given of a number of opposed piston mechanisms built or proposed during the period under review, and the author concludes the article with a detailed account of the development of the Fullagar and Doxford opposed piston engines. J. N.

313. The Chicago Pneumatic Dual Fuel Engine. C. E. Cox. *Gas Oil Pwr*, 1946, **41**, 381.—Difficulties overcome in the operation of this engine are: (1) Poor combustion of the gas in each cylinder; (2) Sticking of the spray valves and injection-pump plunger when small amounts of fuel oil are used; (3) Devising a control system to operate on any proportion of gas and oil fuel. To achieve the latter a Pickering 3200 class governor was employed.

The engine has developed 7500 B.Th.U. per b.h.p.hr, using natural gas of 1100 B.Th.U. per cu. ft + 10% pilot fuel. H. C. E.

314. The Free-Piston Engine. H. O. Farmer. *Motor Ship*, 1947, **27**, 416.—Reference is made to a combination of a free piston gas generator with a turbine for use as a prime mover. I. G. B.

315. The British Gas Turbine. Anon. *Motor Ship*, 1947, **27**, 367.—Describes a 3500 b.h.p. marine gas turbine and reviews other developments, but points out the need for the use of the relatively cheap boiler oil in order that the gas turbine may compete with the diesel engine. I. G. B.

316. Gas Turbine Locomotive Experience. Anon. *Oil Engine*, 1946, **14**, 225.—In an abstract from "The Brown Boveri Review" up to date operating experience is given of the Brown Boveri gas turbine loco supplied to the Swiss Federal Railways in 1941. Improvements in design have increased the rating from 2200 b.h.p. to 2500 b.h.p. with a consequent improvement in efficiency from 17·5 to 19·5%.

In December 1942, test runs were made using bunker oil instead of diesel oil which were completely satisfactory with a fuel consumption equal to that of diesel oil. Tests are also described in which the turbine set was used for braking on down grades in which a braking effort for a given down gradient corresponding to the power output for the up grade could be exerted. By driving the compressor from the traction motors via the main generator, 2200 h.p. at 5200 r.p.m. could be absorbed.

Other tests carried out have shown that air contamination in tunnels was not so serious as with steam locos and that the auxiliary oil engine having a power equal to 4·5% of the rated output of the turbine plant required for starting purposes could, in addition, be used for shunting with complete success.

It is stated that the gas turbine locomotive is at present generally superior to the diesel electric type when operating on bunker oil at 50–60% of the price of diesel oil. C. D. B.

317. The G.W.R. Gas Turbine Locomotive. Anon. *Oil Engine*, 1946, **14**, 252.—Details are given of construction and general design of a 2500 h.p. gas turbine ordered by the Great Western Railway from British Brown Boveri Ltd. and generally similar to that delivered to the Swiss Federal Railways in 1941.

Having a tractive effort of 13,000 lbs at 60 m.p.h. the full load power of the turbine is 10,300 b.h.p. of which 7800 b.h.p. is absorbed by the compressor giving a nett b.h.p. of 2500 transmitted electrically to the outer axles of the two six-wheeled bogies.

The fuel consumption is expected to be less than half that of the equivalent steam locomotive. C. D. B.

MISCELLANEOUS.

318. Chlorinated Hydrocarbon Resin. Anon. *Paint Technol.*, 1946, **11**, 235.—U.S. Patents No. 2,261,748 and No. 2,261,758 issued to J. Bjorksten, relate to the manufacture of resinous materials having fungicidal and insecticidal properties and suitable for varnishes or paints, by the chlorination of cracked petroleum fractions. Fractions boiling from 80 to 240° C and having a bromine value greater than 0·400 are chlorinated almost to saturation then reacted with a polymerizing catalyst of the Friedel–Craft type. The catalyst is removed by distillation or by washing with water to leave a solution of a resin that may be used as a coating composition or incorporated with oil pigments, etc., for the above purposes. W. H. C.

319. Resins from Hydrocarbons. Anon. *Paint Technol.*, 1946, **11**, 234.—In U.S. Patent No. 2,261,759 granted to J. Bjorksten, certain cracked petroleum hydrocarbons are reacted with reactive sulphur and chlorine compounds, *e.g.* sulphuryl chloride, or chlorosulphuric acid, in the presence of a polymerizing catalyst, *e.g.* $AlCl_3$, which is afterwards removed by washing. The products formed vary with the reactants used, and may be solutions of resins or varnish-like materials, which on application to glass, metal, and wood, dry to hard films and have good adhesion. When used as impregnants for wood they have fungicidal properties and are repellent to organisms such as termites. The specification gives the methods of preparing resinous materials for fungicidal compositions, and paints or varnishes. A paint for protecting tanks and metal containers and an inexpensive quick-drying paint for farm use are also described. W. H. C.

320. Related Trends in Future Domestic and Foreign Petroleum Operations. H. W. Page. *Petrol. Tech.* (*A.I.M.M.E.*), July 1946, **9** (4), 1.—During the nine-month period since VJ-Day foreign oil production and refinery operations rose, being respectively 14% and 12% higher in May 1946 than in July 1945. U.S. activities had fallen by 7% and 9% respectively, in the same period. In order to meet foreign demand U.S. has nevertheless had to export large amounts of all products except residual fuel oil. It is expected that foreign operations will continue at capacity, including new installations, while U.S. exports will continue at their present levels. There will be increases in domestic operations and crude production may exceed maximum efficient rates. Even ten years hence some exports from U.S. may be needed, but eventually these will be supplanted by increased output from foreign refineries. Increase in domestic requirements will exceed the decline in exports. Unless crude oil discoveries exceed present expectations, the increased demands will have to be met by increased imports and the synthesis of oil from natural gas and coal. Catalytic cracking will increase, thus aiding in meeting gasoline requirements, but intensifying the domestic shortage of residual fuel oil. G. D. H.

321. The Italian Petroleum Society and Petroleum Research in Italy. R. Gandolfi. *Riv. Ital. Petrol.*, 1946, **161**, 13.—An historical review is given of the development of the petroleum industry in Italy with general indications on the future need for exploration and research. J. F. T.

322. Diesel Fuel and Boiler Oil Prices. Anon. *Motor Ship*, 1947, **27**, 366.—Figures given for boiler oil and diesel oil at representative ports, in August, September, December 1946. The effects on operational economy are discussed. I. G. B.

323. United States Petroleum Industry in the First Half of 1946. Anon. *Petrol. Times*, 12.10.46, **50**, 1062.—Tables are presented of United States oil production, refining and stocks for January to June 1946, and comparative figures for the corresponding period of 1945 are also given. R. B. S.

324. United Kingdom Petroleum Imports in August and the Eight Months of 1946. Anon. *Petrol. Times*, 12.10.46, **50**, 1070.—Statistical data on imports and exports (including oil fuel bunkering of shipping) of crude oil and refined products for August and the first eight months of 1946 are presented, together with comparative figures for 1945 and 1938. R. B. S.

325. Midgley Plaque Dedicated by Ethyl Corporation. Anon. *Chem. Eng. News*, 1946, **24**, 3159.—A description is given of the Detroit research laboratories of the Ethyl Corporation where a bronze plaque in memory of Thomas Midgley, Jr., was dedicated in mid-November 1946. The laboratory possesses facilities for testing power-plant for all types of military equipment at temperatures of −50° F to +145° F. Research on engines for automobiles, trucks, buses, light aircraft, farm tractors, and stationary units can also be carried out, electronic equipment being extensively used in control instruments. L. B.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	82 A
Geophysics and Geochemical Prospecting	83 A
Drilling	83 A
Production	87 A
Oilfield Development	94 A
TRANSPORT AND STORAGE ...	94 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	94 A
Distillation	97 A
Absorption and Adsorption ...	97 A
Cracking	97 A
Chemical and Physical Refining	98 A
Special Processes	99 A
Metering and Control ...	101 A
Patents	101 A
PRODUCTS.	
Chemistry and Physics ...	105 A
Analysis and Testing	110 A
Gas	113 A
Engine Fuels	113 A
Gas and Fuel Oils	114 A
Lubricants	115 A
Bitumen, Asphalt and Tar ...	118 A
Special Hydrocarbon Products	118 A
Derived Chemical Products ...	119 A
Coal, Shale and Peat ...	120 A
Miscellaneous Products ...	120 A
ENGINES AND AUTOMOTIVE EQUIPMENT	121 A
MISCELLANEOUS	123 A

AUTHOR INDEX.

The numbers refer to Abstract Number.

Adelson, D. E., 417
Andrus, D. W., 417
Armstrong, E. N., 425
Arnold, G. B., 417
Arnold, J. C., 417
Asbury, W. C., 417
Aston, J. G., 424
Attaway, D., 385
Atwell, H. V., 417
Auld, S. J. M., 460
Axe, W. N., 417

Bailie, J. C., 417
Barnes, K. B., 366
Barry, A. J., 503
Bartleson, J. D., 417
Batchelder, A. H., 417
Bauer, E. S., 355
Bender, R. O., 417
Bergh, S. V., 479
Berliney, M., 417
Billington, L., 336
Blackburn, B. O., 417
Bland, R. E., 405
Boisselet, L., 468
Bondi, A., 458, 459
Bottomley, H., 388
Bouchet, R. L., 482
Bowden, G. A., 417
Brancker, A. V., 439, 476
Brandt, P. L., 398
Brickwedde, F. G., 424
Brown, G. S., 416
Buchan, R. C., 346
Burk, R. E., 417

Capitani, C., 445
Carlile, J. H. G., 419
Carter, J. C., 417
Cawley, C. M., 419
Chechot, V. L., 417
Cheney, H. A., 412
Clarke, A. E., 431
Clarke, L. A., 417
Clinedinst, W. O., 446
Coffin, R. C., 328
Corcijers, C., 463
Crutchfield, J. W., 379
Cupples, H. L., 417

Daniels, L. S., 401
Delwaulle, F. F., 438
D'Ouville, E. L., 417
Duncan, G. W., 417
Dunn, J. J., 337
Durinski, A. M., 417
Du Pont de Nemours & Co., 417

Egloff, G., 417
Elkins, L. F., 369
Engelking, E. H., 417
Evans, E. A., 417
Everett, E. F., 410
Evering, B. L., 417

Fagin, K. M., 331, 342, 349, 354
Fiekler, J., 480
Flanders, J. E., 384
Flett, L. H., 417
Folkins, H. O., 417
Francois, F., 438
Freund, M., 440, 441, 457
Frey, F. E., 417
Friedman, B. S., 417
Friske, W. C., 453

Garner, F. H., 431
Geckler, R. D., 411
Giammaria, J. J., 417
Gibbon, A., 362, 373
Giblin, P., 396
Gilbert, G. R., 417
Giordano, A., 501
Glowacki, W. L., 417
Goddin, C. S., 456
Goode, C. J., 490
Gordon, S. H., 492
Gorin, E., 417
Gorin, M. H., 417
Gray, R. L., 367
Green, A. D., 417
Green, W. P., 487
Greenfelder, B. S., 417
Gregory, J. N., 483
Griep, E. P., 456
Griesinger, W. K., 417
Groff, J., 461

Haensel, V., 417
Hall, A. C., 416
Hall, C. C., 409
Halverson, L. K., 398
Hamilton, J. P., 417
Hanna, W. S., 427
Hanson, G. H., 434
Harte, C. R., Jr., 391
Hartley, A. C., 502
Hastings, S. H., 417
Hatch, L. F., 417
Hawthorne, W. P., 417
Heard, L., 417
Heath, J. L., 396
Heath, W. A., 361
Heaton, W. B., 417
Heigl, J. J., 417
Hepp, H. J., 417
Hersberger, A. B., 417
Herthel, E. C., 417
Hickle, A. E., 469
Hill, L. R., 410
Hoge, A. W., 404
Hohnstine, J. T., 417
Howe, L. S., 417
Hughes, E. C., 417
Hughes, R. V., 360
Hull, W., 417
Hunter, T. G., 431

Imperial Chemical Industries, Ltd., 417
Ipatieff, V. N., 417
Ippen, A. T., 390
Jahnig, C. E., 417
Joffe, B. V., 444
Jones, C. F., 417
Jones, E. N., 347
Jones, J. P., 417
Jones, P. J., 359, 372
Joone, G. C., 417
Justice, W. H., 347

Kadmer, E. H., 467
Katz, D. L., 434
Keeling, W. O., 417
Kemler, E. N., 357
Kemp, H. S., 434
Kennedy, H. T., 356
Keplinger, C. H., 363, 364, 365
Kingman, F. E. T., 419
Knipling, E. F., 474
Kreulen, D. J. W., 418
Krienke, C. F., 435
Kuhn, C. S., Jr., 417

Laird, H. C., 348
Landoni, A., 380, 381
Lassiat, R. C., 403
Latta, R., 473
Lauterbach, R. A., 406
Lawry, T. F., 374
Lazar, A., 417
Leffer, F. W., 417
Lien, A. P., 417
Lindahl, E. J., 415
Lindahl, J. P., 391
Lindquist, A. W., 474
Lloyd, W. S., 339
Long, A. B., 376
Ludi, W. C., 414
Lunts, D. M., 404

McCloy, W. L., Jr., 350
McCulloch, T. B., 417
McKinney, A. W., 488
McWilliams, L. L., 352
Maass, R., 406

MacDonald, M., 400
MacDonald, R. R., 353
Mack, C., 428, 429, 430
Madden, A. H., 474
Malakoff, H. L., 478
Mason, R. B., 417
Matteson, R., 427
Mazurkiewicz, A. G., 452
Meier, H. H., 417
Metrot, R., 442
Minervini, C., 451
Mitchell, P. J., Jr., 417
Moncrief, E., 344
Monson, L. T., 351
Moore, P. H., 470
Morey, G. H., 417
Moriarty, F. C., 449
Morris, W. S., 375
Moskow, M., 424
Mullins, B. P., 420
Myles, J. R., 417

Nelson, W. L., 393, 394, 436, 481
Newall, H. E., 419
Noll, H. D., 404
Nygaard, E. M., 417
Nysewander, C. W., 411

Oberfell, G. G., 447
Oberholzer, V. G., 452
Oblad, A. G., 417
O'Connell, H. E., 387
Oliveira de, A. I., 382
Opdyke, E. G., 434
Owen, J. J., 417

Patterson, J. A., 417
Pederson, C. G., 417
Penn, W. S., 475
Perkins, R. B., 398
Perry, S. F., 413
Peterson, W. H., 417
Pfister, R. J., 345
Pipparelli, E., 451
Pruett, H. T., 379
Putz, T. I., 491

Ragatz, E. G., 399
Rankin, C. H., 332
Raucourt, M., 482
Raymond, C. L., 412
Reiff, O. M., 417
Reis, M. T., 498
Reis, T., 432
Richards, R. B., 417
Richardson, J. A., 399
Riester, W. F., 392
Robert, L., 443
Roberti, G., 451
Robertson, A. E., 417
Rollins, F. S., Jr., 417
Russell, H. M., 344

Salathiel, R. A., 417
Saurino, B., 383
Scarth, V., 417
Scheuermann, L. N., 377
Schmerling, L., 417
Schroeder, H. O., 474
Schuls, J. W.,454
Schulze, W. A., 417
See, M. J., 391
Semmola, E., 451
Seyfried, W. D., 417
Shankland, R. V., 417
Sharp, L. G., 417
Shell Deu Co., 417
Shepardson, R. M., 417
Shimansky, L. F., 397
Shimer, J. M., 341
Short, G. H., 417
Shreeve, C. A., 487
Shvemberger, N. A., 326
Simonetta, M., 445
Sleskin, N. A., 465
Smith, E. A., 405
Smith, J. E., 417
Sneddon, R., 378
S.O.C. California, 417
Steiner, K., 455
Sterrett, E., 358
Stoneman, A. C., 417
Stuart, A. H., 462, 463
Stueve, W. H., 395
Sumerford, S. D., 417
Swaney, M. W., 417
Swearingen, J. E., 411

Taliaferro, H. B., 391
Tartarani, G., 407
Taylor, H. S., 417
Tcherkezoff, N., 432, 433
Thacker, C. M., 417
Thaler, M. L., 437
Thayer, C. H., 403
Thomas, R. W., 447
Thornton, O. F., 370
Trinidad Leaseholds Ltd., 417
Trumpler, P. R., 389
Tucker, A. J., 330
Turkevich, J., 417
Turner, B. B., 417
Twigg, G. H., 421, 422, 423

Uhlig, H. H., 386
Uspenskaya, N. J., 464

Velde, H., 448
Ventura, B., 450
Villar, G. E., 477
Vincent, G. A., 410
Voiret, E. G., 500
Volman, D. H., 426
Voorhees, V., 417

Wakefield, C. C., & Co., Ltd., 417
Walker, J. C., 478
Wanenmacher, J. M., 365
Wasson, J. I., 417
Weaver, D. K., 335
Weber, B. V., 329
Weber, G., 338, 343
Welensky, I. H., 417
Welling, C. E., 417
Whaley, T. H., Jr., 417
Whittaker, D., 417
Wiemann, J., 438
Willing, C. E., 417
Wilson, G. M., 334
Wilson, J. A., 417
Wilson, W. W., 368
Wolf, A., 466
Woolnough, W. G., 327

Zabel, H. W., 408
Zanetta, A., 380, 381
Zech, J. D., 417
Zimmerman, G. B., 417

Oilfield Exploration and Exploitation.

Geology.

326. Disthene-Staurolite Association of Minerals in the Meso-Cenozoic of the South-Emba Oil-Bearing Region. N. A. Shvemberger. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **53**, 459 (in English).—Previous views on the source of supply of clastic material in the Mesozoic for the South Emba region are revised on the basis of more extensive data on the mineralogical composition of the rocks of the Lower Jurassic, Valanginian, and Cenozoic of the Emba region. The disthene-staurolite association of minerals occurs only in the first two series and it is suggested that during the period in which these series were formed, disthene-bearing clastic material was supplied from the Russian platform, previously studied by Baturin. G. H. B.

327. Distribution of Oceans and Continents. W. G. Woolnough. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 1981.—This paper attempts to reconcile the tetrahedral theory and Wegener's hypothesis regarding the distribution of oceans and continents on the earth's surface. These theories are normally mutually contradictory.

The author suggests that while the tetrahedroid tendency of a contracting and solidifying globe has played a very important part in earth history, its initial stages of development were interfered with and distorted by the early asymmetrical development of the Pacific Ocean basin. It is suggested that Darwin's belief that the Pacific Ocean represents the scar left on the earth by the tidal separation of the moon should be now re-examined. Reasons are given for supposing that such an injury caused a deformity of the embryonic tetrahedron, and that the presence of the Pacific scar caused the displacement of the Antarctic quoin towards South Africa, and twisted the dihedral edges of the tetrahedron, forming the Gondwana continent.

The " traumatic lesion " of the earth is considered more severe in the South Pacific than in the North, resulting in the development of the northern continental masses in the high northern latitudes.

As cooling of the earth progressed, the tetrahedroid tendency developed in deeper zones which were not controlled by the Pacific scar. The roots of the continental masses were carried nearer to the positions of ideal tetrahedroid symmetry.

It is thought that it was not until the initiation of the Hercynian diastrophism that the "dehiscence" of the Gondwanaland knot occurred, initiating the extensive continental drift of the southern continents and India. India has not yet reached its normal tetrahedral position, having been delayed by having had to plough through the thick mass of the south-western Asiatic geosynclinal sediments. In its later movements India has caused the crumpling of the great Himalaya complex of mountains.

South America also has not yet reached its final position in the tetrahedral symmetry. When it does so, it will become exactly antipodal to the Caspian–Turkestan area.

Finally, it is suggested that when the Pacific was produced by moon lesion, the ragged edges of the scar were left and have persisted ever since as a circum-Pacific ring. This ring may have had a profound tectonic effect, and its presence may explain the distribution and limitation of Laramide folding, and the tectonic complexities of the Caribbean, Moluccan, and Falkland Island regions. E. N. T.

Geophysics and Geochemical Prospecting.

328. Recent Trends in Geological–Geophysical Exploration and Methods of Improving Use of Geophysical Data. R. C. Coffin. *Bull. Amer. Ass. Petrol. Geol.*, 1946, **30**, 2013.—Statistics are given of the increase of geophysical exploration in recent years. Since 1942, gravimetric methods in the United States have been increased by 200%, seismic methods by 50%, core drilling by 100%, and magnetic surveys by 70%.

In spite of the tremendous increase in the use of the gravity method, which is discussed in detail, there has not been a corresponding increase in the understanding of its proper application and limitations.

It is submitted that a tremendous improvement in geological thought and a more economical use of expensive geophysical data would be made possible by the education of district geologists in geophysical concepts. There is already a trend in this direction, but its acceleration is considered most necessary. E. N. T.

329. Oil-Bearing Basins, Their Facies and Conditions of Accumulation of Source Material for the Formation of Oil. B. V. Weber. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **53**, 447 (in English).—Some of the geological and hydrochemical conditions necessary for the accumulation of petroleum source materials in potential oil-bearings basins and their subsequent conversion into petroleum, are discussed. The most typical feature of such basins is their half-closed nature and they are considered to have been bays divided from the sea by sub-aqueous ridges or reef barriers. The favourable effect of the resulting threshold conditions on the development and accumulation of organic material is described with some present-day examples. The influence of geological and other factors on the subsequent conversion of these accumulations into petroleum is also outlined. G. H. B.

Drilling.

330. Bollard Method for Shallow-Water Drilling. A. J. Tucker. *Oil Wkly*, 16.9.46, **123** (3), 98.—A bollard, in maritime terminology, is a combination fender and mooring, usually a driven-pile cluster with bitt or cleat on top. In this respect, it describes the protective device around the submerged well-head, which has the companion purpose of serving as pivot point for the ship to retain the rig over the hole. A design is proposed for shallow-water drilling using a bollard. In the design it is envisaged that a landing ship tank is converted for drilling by installing a derrick and requisite machinery on the forecastle head. In the hull, where the bow ramp aperture was located, an alteration has been accomplished so that drilling can be conducted through the bottom of the ship. On deck and abaft the rig, pipe racks have been installed on either side of the centre line to hold drill stem, casing, and spare pipe. Between these racks, the lowdown device travels. Vessel is moored to four buoys on bow and quarter and is sunk on to the ocean floor. The bollard is sunk in position in the drilling chamber and is enclosed within the three walls and the bow doors, thereby serving as pivot point for the ship. Through the bollard, drilling operations are conducted. Certain details of safety measures and of design factors affected by the peculiar conditions of the hydrography of the problems are presented. A. H. N.

331. Large Power-Type Rig in W. Texas Unitized to Facilitate Moving. K. M. Fagin. *Petrol. Engr*, August 1946, **17** (12), 154.—The rig layout employed for drilling the Humble Oil and Refining Company's Harris No. 1 Well in Sterling County, Texas, is described. Details are given of engine substructures (accompanied by detailed drawings), water system equipment, pipe rack design, and other lesser features.

R. B. S.

332. Improved Wyoming Drilling Technique. C. H. Rankin. *Oil Wkly*, 9.12.46, **124** (2), 58.—An innovation in drilling introduced in the Rocky Mountain region is that of drilling a full 17½-in hole for the surface casing without first drilling a pilot hole. In this field the casing programme calls for setting 2500 ft or more of 13⅜-in outside diameter surface casing. Conductor, 90–100 ft of 22-in casing, is welded in the derrick and run as a unit.

A. H. N.

333. Magnolia Company's Open Gulf Test in Below 8400 ft. Anon. *Oil Wkly*, 28.10.46, **123** (9), 31–32.—The progress made by the well being drilled in the open waters of the Gulf of Mexico, located 5 miles from the nearest land, is reported. The derrick is on a man-made island forming the substructure. A special feature of the derrick foundation was the provision for drilling three wells from the one foundation by skidding the derrick substructure forward or backward to two other positions. This was made possible by the use of a special substructure design which transferred all derrick floor loads to corner and side columns of the substructure. The substructure in turn was fastened to an upper skid beam assembly resting on a lower skid beam assembly, which in turn was supported on the steel wide flange beam caps of the steel pile foundation. An upper and lower skid beam assembly combined was made up of six 10-in wide flange 89-lb beams. Caps for the steel piling were 17-in dia × 1½-in base plates welded to the top of each piling and being joined by welding to the wide flange beam caps resting thereon.

Details of material requirements are presented. Communications are by radio.

A. H. N.

334. Diamond Core Bits Give High Recovery. G. M. Wilson. *Oil Wkly*, 2.12.46, **124** (1), 24–25.—A new type core barrel employing an improved diamond bit cutting-head is described. It has been used successfully in the Rangely field, Colorado. The diamond bit, placed on the bottom of a 25-ft core barrel, cuts a 6¼-in hole and 3¾-in core. One hundred per cent core recovery has not been uncommon, with 25-ft solid Weber sand cores frequently being taken from the barrel. In one well core recovery was 100%, the average cut/bit being 88 ft, and with coring time averaging 9·6 min/ft. In comparison, a conventional core barrel used on a similar section of the hard sandstone in this well, cored at the rate of about 43 min/ft. Complete and largely unbroken core recovery is attributable to both the design of the diamond core head and to the construction of the barrel, the latter actually consisting of two barrels, one inside the other. The inner barrel, which takes the core, is stationary, while the outer one, to which the diamond core head is attached, is rotated by the drill-pipe. A free-floating ball-bearing race between the top of the inner barrel and outer barrel allows the inner barrel to remain stationary as the core slides into it. The circulating fluid flows around the inner barrel and through water courses in the bit, thus minimizing core flushing. After filling the inner barrel, the bit is pulled off bottom, allowing the split ring core catcher to pull down in a tapered sub above the bit. This action breaks off the core, the latter then being held in the inner barrel for removal to the surface. With the exception of the core barrel and the several special tools and wrenches used in handling it while it is out of the hole, all coring operations are conventional. Drilling mud is the same as that used in coring with conventional barrels. Photographs illustrate the bit.

A. H. N.

335. Practical Aspects of Directional Drilling. D. K. Weaver. *Oil Gas J.*, 16.11.46, **45** (28), 263. (*Paper presented before A.P.I.*)—Directional drilling of rotary holes has become common practice in the oilfields, with recognition of the savings to be made by exploiting additional reserves in locations too costly or inaccessible for vertical drilling. In limited use in the Signal Hill field from about 1927 to 1930, real development of high-angle directional drilling occurred during 1938 with the tapping of the

rich oil pool lying beneath the tidelands off Huntington Beach, Orange County, California. This paper gives the practical side of directional drilling with control methods other than with deflecting tools. A. H. N.

336. Maintenance Procedure in the Field for I.C. Engines. L. Billington. *Petrol. Engr*, September 1946, **17** (13), 74.—The duties of the travelling mechanic, and the necessary equipment of a travelling workshop for servicing engines in the field are discussed. R. B. S.

337. Warm Worked Casing. J. J. Dunn. *Petrol. Engr*, September 1946, **17** (13), 96. —In processing warm worked casing, the final reduction to size ranging up to some 8% of the diameter is made at a temperature between the blue brittle range and the lower critical temperature. The result is a casing of high transverse compression and longitudinal tension properties. The increased transverse compression strength results in a high collapse resistance and the increased longitudinal tension strength to increased joint strength. Also a wide range of these improved properties is possible by variation of the per cent reduction and temperature.

The theory and development of the process are described in detail and test results are also given. R. B. S.

338. Deeper Drilling Necessitates that Greater Emphasis be Placed on Drill-Pipe Testing. G. Weber. *Oil Gas J.*, 31.8.46, **45** (17), 72.—Drill-pipe defects are of two distinct classes: Those occurring as a result of fabrication, and those resulting from handling, corrosion, or stress in service. Rolled-in scale, laps, seams, and cut plugs appear to have caused some failures in new drill pipe. This is indicated in cases where new drilling strings suffered several early failures, then continued in use through their normal service life without abnormal trouble. At present, steel mills employ careful control over the manufacturing and fabrication processes, followed by visual inspection of the finished product. Such inspection covers dimensional tolerance, concentricity, thread accuracy, and examination of laps and seams. Laps and seams which have opened and the depths of which exceed 12½% of wall thickness are rejected. However, such defects which have not yet opened at the mill are often invisible and their depths are unknown without destructive testing. Several non-destructive testing methods are described in the paper for field or shop testing. Magnetic particle inspection and the fluorescent penetrant method are cited as aids to visual inspection, along with automatic testing methods which would indicate defects to be further inspected by skilled personnel. The latter methods involve techniques based on a number of principles, including surface magnetic field measurement, diffraction or back reflection of gamma rays and X-rays, hysteresis and eddy current losses, and conduction of heat, electric currents, vibrations, supersonic waves, X-rays, and other radiations. In addition to the regular inspection methods now in use, the adoption of a low-cost visual inspection aid such as Magnaflux or Zyglo is suggested. Either of these commercial methods could be employed in inspecting about one in every hundred joints of pipe passed by regular inspection. The new method could also be used in further study of joints rejected by the initial visual inspection, followed by grinding down or sectioning of defective areas and complete cataloguing for future reference and analysis. Subject to determination of actual effect of each type of mill defect on service life, automatic scanning devices are suggested as possible important supplements to visual inspection in the future. A. H. N.

339. Surface Preparation and Drill Pipe Fatigue Failure. W. S. Lloyd. *Oil Wkly*, 9.12.46, **124** (2), 46.—Failure of drill pipe by fatigue is recognized and accepted limits for air fatigue for materials are set; corrosion fatigue is more difficult to specify as it depends on the conditions under which it obtains. Under conditions of combined corrosion and fatigue, failure has been found to occur at much lower stress than for plain fatigue or notch fatigue in the absence of corrosion. Various methods, mainly by coatings both metallic and non-metallic, have been tried to combat the effect of corrosion. The usage drill pipe encounters, while not prohibiting such coatings, does make them of less value than for other types of material. Besides the use of coatings the effect of surface finish has also come under consideration, and arguments have been proposed in the field that a surface finish different from mill-scaled finish would be

beneficial. Since surface finish is more applicable to drill pipe than coatings, this factor was investigated both for air fatigue resistance and corrosion-fatigue. The experiments undertaken and their results are described. The corrosion-fatigue results are quite different from the air fatigue. Here it is clearly shown that, regardless of type of surface treatment within the limits of test error, there is no difference in the behaviour or resistance to combined corrosion and fatigue. Notches are present, whether formed mechanically or chemically, and surface treatment has no effect on notch sensitivity. Where a durable film can be retained under stress encountered in service, such as exhibited by so-called corrosion-resistant or stainless material, the problem becomes more one of plain fatigue than corrosion-fatigue. Also, even though the effects of corrosion are not prevented, of several grades of steel the one having the least notch sensitivity will be the most acceptable for service under conditions of fatigue and corrosion. Unless conditioning increases the length of service of drill pipe to an acceptable expected life, either corrosion-resisting materials or materials having low notch sensitivity may be necessary in certain cases. A. H. N.

340. Selection of I.C. Engines for Field Use. Anon. *Petrol. Engr*, September 1946, **17** (13), 57.—The mathematical and engineering considerations in the selection of engines for hoist and pump duties are outlined and illustrated by simple calculations. The other general considerations which are involved are also discussed. R. B. S.

341. Improvements are Needed for Pumping Compressible Rotary Mud. J. M. Shimer. *Petrol. Engr*, August 1946, **17** (12), 131.—The serious effect which the compressibility of some muds has on the volumetric efficiency of mud pumps is illustrated by a few simple calculations. Various means of reducing this effect to a minimum are discussed. R. B. S.

342. New Rotary Tool is Used to Keep Drill-Pipe Free. K. M. Fagin. *Petrol. Engr*, October 1946, **18** (1), 272.—This new tool consists of a steel sleeve mounted slidably on a mandrel placed between the drill pipe and drill collars: the outside diameter of the sleeve is slightly larger than the outside diameter of the drill collars. The sleeve normally turns as drilling proceeds, but if it becomes stuck the entire drill stem can be lowered about 2 ft and rotated without turning the sleeve: it can then be removed by jarring or by pulling up and rotating. The drill collars are unlikely to stick owing to their smaller diameter.

The tool is described in detail and is illustrated by photographs and drawings. R. B. S.

343. Sodium Chromate Used in Permain Basin Drilling to Combat Salt-Water Corrosion. G. Weber. *Oil Gas J.*, 7.12.46, **45** (31), 103.—Sodium chromate concentration of about 1800–3000 p.p.m. is used to reduce corrosion fatigue, 50–100 lb of chemical to about 50 gal of water being introduced to the flow line at the rate of about 50 g.p.h. Once the correct chromate concentration in the mud has been reached, small daily additions will maintain proper proportions. Cost is 6 cents per foot drilled. Use of chromate not likely to extend at present owing to the shortage of supplies and increased demand. G. A. C.

344. Pressure Maintenance and Gasoline Absorption Plant in Santa Barbara Field, Venezuela. H. M. Russell and E. Moncrief. *Oil Gas J.*, 28.12.46, **45** (34), 164.—Wet gas from the field separator stations at 50 lb pressure is processed in the plant and dry absorber gas returned to the producing formation at about 2300 lb pressure. The pressure-maintenance plant consists of one vacuum and six three-stage 6-cylinder compressors, with a daily capacity of 21,000,000 cu ft of gas.

Injection is into 13 wells, the 13,500,000 cu ft returned will soon be increased to 16,500,000 when three other wells are brought into the system.

A gasoline plant of 25,000,000 cu ft of gas capacity extracts propane, *iso*-butane, *n*-butane, *iso*-pentane and heavier. Motor gasoline, kerosine or absorption oil is manufactured on the two-column crude unit. A dehydration plant can treat 25,000,000 cu. ft of natural gas per day, using Al_2O_3 desiccant. When compressed to 2500 lb the dew-point does not exceed 50° F after treatment.

A crude treating plant of 6–8,000 brl per day of raw crude handles the cut oil produced in the field, a process of heating and chemical treating being employed.

Water requirements necessitated a water station at artesian wells located ¾ mile from the plant site, the water being softened before use in the plant. Ancillary electrical and steam-generating plant have also been installed. G. A. C.

Production.

345. Acidizing Increases Water Intake Rates. R. J. Pfister. *Oil Wkly*, 11.11.46, **123** (11), 70.—It has been found that waters of low pH increase the intake rates of tight sands. However, low pH water and brines show a favourable effect only as long as these waters are entering the sand face; the rates decrease when fresh water is again injected, but acidization is directed to leave a permanent change in the well which will maintain a permanent increase as long as clear, sediment-free water is injected in the well. Acidization of production wells has become very successful in other areas, particularly in limestone formations, but more recently sandstones have also been successfully acidized with the development of special acids. In these wells, a treatment often involves the use of 3000 or more gallons of acid injected at several thousands of pounds pressure. While such practice is rather common, the equipment is elaborate and the service expensive in secondary recovery operations. It therefore seemed desirable to carry out some experiments with acidization in an attempt to devise an inexpensive treatment. In order to determine if these experiments are truly successful, it is necessary to follow the water input rates before and after acidization and to gauge water and oil production. The work to date is only a start but the results are encouraging. The desired method of preparing a well for acidization and the one ordinarily employed is described.

The treatment of 9 experimental wells and the results obtained are described. The intake rates generally increased. A. H. N.

346. Corrosion and Preventive Methods in the Katy Field. R. C. Buchan. *Oil Wkly*, 18.11.46, **123** (12), 25. (*Paper presented before A.P.I.* 12.11.46.)—The Katy gas-condensate field and the producing and cycling equipment used in its production are described. The effects of acidic water corrosion are illustrated and discussed. The use of plastic-coated pipe and the use of soda-ash as a neutralizing agent are described as being practical means of reducing corrosion losses in the Katy field. The need for continued research and for field testing of alloys is pointed out. Instead of waiting for a complete understanding of such problems, it is advocated that full-scale field tests be initiated as soon as corrosion is found in new fields. The arrangement of subsurface equipment to facilitate corrosion control is discussed briefly. The importance of keeping equipment in safe working condition is emphasized. A. H. N.

347. Tests at Cycling Project Demonstrate Possibilities of New Corrosion Inhibitor. W. H. Justice and E. N. Jones. *Oil Gas J.*, 9.11.46, **45** (27), 86. (*Paper presented before Nat. Gasoline Assoc. of Amer. Corrosion Research Project Committee.*)—In an attempt to inhibit corrosion in gas-condensate wells in Texas, a chemical called "Kontol 115" made by Tretolite Co. was tested. After extensive laboratory test, this material was found to have the following properties. It is a semipolar organic reagent which is chemically attracted to metal surfaces. The adherent, invisible protective film thus formed inhibits the attack of the metal by corrosive materials. This material is completely oil soluble and has no tendency to form precipitate with magnesium and calcium salts. Tests were performed on field scale and the results are presented and appear to confirm the efficacy of the material in inhibiting or retarding corrosion.
A. H. N.

348. Mechanics and Economics of Dual Completions. H. C. Laird. *Petrol. Engr*, August 1946, **17** (12), 165.—A brief outline is given of dual completions in California and the Mid-Continent. Some of the problems encountered and the methods of overcoming them are discussed: tools and other equipment used are described in detail and well illustrated by diagrams. The paper ends with a review of new equipment being developed. R. B. S.

349. Estimating Crude Oil Reserves. K. M. Fagin. *Petrol. Engr*, September 1946, **17** (13), 92.—The three usual methods of estimating reserves are (1) the production decline curve method, (2) the volumetric method, and (3) the analytical method. The

first method cannot be used until the production has declined naturally for two or three years: the estimates by this method vary according to the economic limit which the producer fixes for the rate of production as the reservoir nears depletion. The volumetric method takes into account (1) the areal extent of the reservoir, (2) the sand thickness, (3) the porosity, (4) the connate water content, and (5) the shrinkage factor of the oil: the estimates by this method also vary with the recovery factors assumed for the various reservoirs. The analytical method only receives brief mention at the end of the paper. R. B. S.

350. Separators and Tanks. W. L. McCloy, Jr. *Oil Gas J.*, 16.11.46, **45** (28), 281. (*Paper presented before A.P.I. as part of A.P.I. Symposium on Secondary-Recovery Projects.*)—Consideration is given to methods and equipment used in the delivery of oil from the well as "well fluid" through the various stages of separation to the stock tanks as "pipe-line oil". Various methods and equipment "hook-ups" for treating emulsions are set forth diagrammatically. A. H. N.

351. The Chemical Demulsification of Crude Oil. L. T. Monson. *Petrol. Engr*, September 1946, **17** (13), 69.—The use of chemicals in the demulsification and desalting of crude oil and their adaptability for the demulsification of other water-in-oil emulsions is briefly discussed. R. B. S.

352. Source and Purification of Gas Supply. L. L. McWilliams. *Oil Wkly*, 25.11.46, **123** (13), 38. (*Paper presented before A.P.I.* 12.11.46.)—The types and sources of gas for injection purposes are discussed. A list of undesirable gases is presented and the tests for these gases and methods for their elimination are indicated. Finally, a brief study of the economics of purification of injection gas is made. The chief components to be removed are hydrogen sulphide, carbon dioxide, oxygen, and water vapour. A. H. N.

353. Economics of Modern Oil Treating. R. R. MacDonald. *Oil Wkly*, 16.12.46, **124** (3), 14.—It is urged that oil producers should entrust the treatment of the oil, to obtain clean oil within the specifications for water content and gravity, to an expert whole-time oil treater whose responsibility should be to provide adequate treating equipment for any emergency. Examples are quoted where treating the oil efficiently has not only saved its own cost and kept the supply of oil up to the limit of the demand, but also produced good dividends. General remarks about the care to be taken in maintaining treating equipment are made. A. H. N.

354. Development Economics of Hawkins Oil Field. K. M. Fagin. *Petrol. Engr*, August 1946, **17** (12), 92.—A brief account is given of the development of the Hawkins oilfield in Wood County, Texas. Production is from the Woodbine sand: the geology and structural characteristics are described and details are given of reservoir pressures, oil shrinkage, and oil recovery factors. R. B. S.

355. Plastic Plugging Reduces Gas-Oil Ratios. E. S. Bauer. *Oil Gas J.*, 31.8.46, **45** (17), 88.—The plugging material described is Resinox, a phenolic, low-temperature curing resin. To run in for a gas plug, a temperature survey must be first made by using a continuous-recording temperature bomb. Since the gas area is generally at a lower temperature than the oil level, a study of the temperature curve will indicate the approximate location of the gas-oil contact. The well is pumped full of oil to overcome and seal off the gas pressure. Depending upon the depth of the well and the amount of pressure experienced, between 6 and 8 hrs will be required for this operation. While oil pressure is maintained, the tubing is pulled from the well. In most cases it will not be necessary to maintain positive pressure since the pressure caused by the hydraulic level of the oil will usually be sufficient. Depending upon the type of equipment used, total set-up time and pulling time will require between 8 and 24 hrs. With new, high-speed equipment, this time is reduced materially, and it is possible to pull 5000 ft of tubing in about 2½ hrs. A special drillable plastic bridge is run in on a wire line to a point slightly below the gas-oil contact and is sealed to the wall with plastic cement. This prevents the resin sealer, which will be added later, from going into the oil pay. The tubing is now re-inserted until it rests on the top of the bridge. Using a

specially constructed pumping truck, the plastic is then pumped through the tubing into the well. The well is capped and between 200 and 800 p.s.i. pressure is applied. This forces the Resinox out through the porous structure from which the gas is intruding. The resin is allowed to cure for 6–8 hrs, after which the well is drilled and cleaned. A. H. N.

356. Use of Plugging Agents. H. T. Kennedy. *Oil Wkly*, 18.11.46, **123** (12), 61. (*Paper presented before A.P.I.* 12.11.46.)—Recent developments in the use of plugging agents in secondary-recovery operations are discussed. These include the use of various finely powdered solids—such as cement, colloidal clays, and wax distillate—which are added to the water at the input well in water flooding. The use of smokes of various compositions, as applied to gas- or air-repressuring projects, is also discussed. The plugging of water, which by-passes oil in fields which are not being artificially flooded or repressured, conserves propulsive energy, and allows commercial production of oil that could not otherwise be obtained. It may, therefore, be considered as a method of secondary recovery itself, comparable in importance with repressuring or water flooding. Recent developments in this field are discussed. A. H. N.

357. Pumping-Equipment Selection for Secondary-Recovery Developments. E. N. Kemler. *Oil Gas J.*, 16.11.46, **45** (28), 287. (*Paper presented before A.P.I. as part of A.P.I. Symposium on Secondary-Recovery Projects.*)—Summary data are given on horse-power requirements available on small and shallow wells. Proper counter-balancing is a most important factor to be considered, both on central powers and beam wells. A. H. N.

358. Hard-Faced Valve Seats Extend Pump Life. E. Sterrett. *Oil Wkly*, 11.11.46, **123** (11), 54.—It is stated that whilst the money cost of servicing oilfield pumps and auxiliary equipment may be negligible, the monetary loss sustained through prolonged shut-downs due to failure of these equipment may be considerable. One of the operating divisions of The Pure Oil Co. has worked out a method for reconditioning worn valve-seat spiders and replacing the wearing surface with hard-facing material to take the pound of the valve. Through adoption of this revamping of pump design, the effective service life of the spider has been extended from the former three or four-month replacement schedule to an average working life of a like number of years—extending the interval between replacement shut-downs 12 times. Photographs supplemented by descriptions give the method of hard-facing the valve seats. A. H. N.

359. Oil Production by Water. Part 2—Dry-Oil Recovery for Uniform Distribution of Pay. P. J. Jones. *Oil Gas J.*, 9.11.46, **45** (27), 88.—The oil recoverable before edge water appears in production varies with a number of factors including the distribution of pay. This article is limited to uniform areas/foot of dip distance and to uniform pay thickness. For such structural and stratigraphic conditions, the acre-feet of pay invaded by water/foot of updip advancement is uniform. The in-place oil varies with porosity, interstitial water, and volume factor. The recoverable oil depends on the fluid factor. The latter varies with the volume factor for oil and with the viscosity ratio of reservoir liquid to that of water. The oil displaced ahead of water in a given reservoir depends on the distance advanced by water before reaching producing wells. Two contours called B and M are used in estimating producing rates. The structural position of the B and M contours varies with time. A. H. N.

360. Importance of Research in Secondary Recovery Water Flooding. R. V. Hughes. *Petrol. Engr*, August 1946, **17** (12), 180. (*Paper presented at annual meeting, North Texas Oil and Gas Association, Wichita Falls, Texas, March* 1946.)—A thorough understanding of the permeability distribution and structural conditions of reservoir sands, and the location of edgewaters and gas caps is of prime importance in all secondary recovery developments. A factor known as the specific injectivity index is suggested as being of more value to the secondary recovery operator than mere permeability values: specific injectivity index is defined as the input rate in barrels of water per day for each foot of sand per pound sand face pressure.

The need for proper treatment of input waters is also stressed. Treatment of fresh waters should consist of removal of iron and manganese by aeration, addition of chlorine or copper sulphate for control of organic growths, addition of lime to raise the pH in an effort to help prevent corrosion, and filtration to remove all suspended matter that might clog the sands. It is also suggested that all input waters should possess the added property of keeping the clay and clay-like minerals of sands in a permanently flocculated condition. Salt waters and produced brines flocculate the clay-like minerals in a sand as will waters on the acidic side, but one big objection to the use of brines or acidic waters is increased corrosion. It has been found that corrosion can usually be reduced by thorough removal of the dissolved oxygen, but research is necessary to find or develop chemicals that could be added to treated, high pH waters, to give them the flocculation of clay properties.

Selective plugging practices for the reduction of by-passing are still in the experimental stage, but chemical plugging agents and plastics seem to offer the greatest possibilities in this direction. Finally, the present status of reservoir fluid flow research is reviewed. An excellent bibliography of twenty-one references is appended.

R. B. S.

361. Utilization of Old Wells. W. A. Heath. *Oil Wkly*, 18.11.46, **123** (12), 35. (*Paper presented before A.P.I.* 12.11.46.)—The prime advantage of using old wells is a large saving in development cost. Disadvantages consist of irregular spacing, poor mechanical condition of the well bore, exposed gas, or thief formations which may be difficult to isolate because of having been shot with nitroglycerin. Deposition of paraffin and other residues in the well bore is troublesome in certain areas—particularly in the eastern district; and, if not removed prior to conversion of an old well to an input well, it may greatly reduce the efficiency of the driving medium. Methods and suggestions for removing the paraffin are given. In the Mid-Continent district little difficulty is encountered in deposition of residues, and no special precaution other than a mechanical clean-out is performed in conversion of a well to input. In some instances precipitation of calcium, barium, or strontium salts on the sand face has occurred, and special treatment is required. Reasons for intensive secondary-recovery development as practised in certain areas are discussed. A. H. N.

362. Secondary Recovery in the Nowata–Claggett Area. A. Gibbon. *Oil Wkly*, 9.12.46, **124** (2), 48.—The history and development of the pool previously to secondary recovery is summarized. Characteristics of the sand and production data are presented. A factor "C" is developed which represents the barrels/acre-foot at well density of 5 acres/well multiplied by 1·6. The method of estimating the factor "C" and of using it is discussed in some detail. Economic studies of the field are briefly presented. A. H. N.

363. Distribution Systems and Surface Injection Equipment in Secondary Recovery. C. H. Keplinger. *Oil Wkly*, 2.12.46, **124** (1), 42. (*Paper presented before A.P.I.* 12.11.46.)—Consideration has been given to distribution systems and well-injection equipment for secondary recovery of oil by air, gas, and water. Economical distribution systems may be designed on a sound engineering basis if the important factors such as volumes, pressures, and expected life of proposed projects are accurately estimated. Standard surface well-injection equipment may be varied to meet local conditions. Individual well meter equipment should be provided for every project.

A. H. N.

364. Distribution Systems and Surface Injection Equipment. C. H. Keplinger. *Oil Gas J.*, 16.11.46, **45** (28), 300. (*Paper presented before A.P.I. as part of A.P.I. Symposium on Secondary-Recovery Projects.*)—Consideration is given to distribution systems and well-injection equipment for secondary recovery of oil by air, gas, and water. Economical distribution systems may be designed on a sound engineering basis if the important factors such as volumes, pressures, and expected life of proposed projects are accurately estimated. Standard surface well-injection equipment may be varied to meet local conditions. Individual well-meter equipment should be provided for every project. A. H. N.

365. Operators in Hull and Silk Field Study Repressuring Programme. C. H. Keplinger and J. M. Wanenmacher. *Oil Gas J.*, 31.8.46, **45** (17), 76.—The history of the Hull and Silk field in Texas is reviewed, followed by a detailed description of the more important and significant horizons. Data on the gas–oil ratios obtained for the different sands are presented and oil reserves are estimated. It is estimated that in order to obtain the anticipated 5,300,000-brls increase in oil recovery, it will be necessary to inject approximately 22,000,000 M.c.f. of gas. It is believed that this gas be injected at a pressure of 750 p.s.i. The main expense of the injection programme will be the charges for compressing gas. Based upon a possible pressure service of 2 cents/M.c.f., the total cost of compressing the gas will amount to 440,000 dollars. Purchase of gas meters for injection wells and conversion of oil wells to gas injection wells should not amount to more than 250 dollars/well. The cost may be increased, however, if it is found necessary to deepen proposed gas-injection wells so as to expose all of the pay section being produced by other wells in the vicinity. A. H. N.

366. 11,667 Productive Acres Repressured in West Pampa Co-operative Project. K. B. Barnes. *Oil Gas J.*, 9.11.46, **45** (27), 66.—The field is composed of 101 leases. Preliminary studies were started in 1943; on March 25, 1946, the first eleven injection wells were put into operation. The organization of personnel and responsibilities is briefly explained. Similarly brief discussions are made of the gas–oil ratio tests, of reconditioning the oils and of level determination in input wells and other engineering data. The following table summarizes the data up to September 1946.

Gross oil production, b.d.	11,308
Average production/producing well, b.d.	12·63
Gas production, M.c.f./day at 14·65 pressure base	17,701
Gas injected, M.c.f./day at 14·65 pressure base	4,338
Per cent of produced gas injected	24·5
Produced gas–oil ratio, cu. ft/brl	1,565
Injected gas–oil ratio, cu. ft/brl	384
Net gas–oil ratio, cu. ft/brl	1,181
Maximum injection pressure, p.s.i.	479
Minimum injection pressure, p.s.i.	93
Average injection pressure, p.s.i.	261
Producing days	30
Number of input wells in service	75
Number of producing wells	895
Total acreage in repressure area	11,667
Average oil recovery, brl/acre	6,062
Cumulative oil production as of September 30, 1946, brl	70,722,883
Cumulative gas injected since March 25, 1946, M.c.f.	763,489

A. H. N.

367. Langlie Unitized Repressuring Project. R. L. Gray. *Oil Wkly*, 25.11.46, **123** (13), 32. (*Paper presented before A.P.I.* 12.11.46.)—The results of 5 years of operation under a gas injection programme are summarized. The project known as the Langlie Unitized Repressuring Project is located in south-eastern New Mexico. The project was started when the average reservoir pressure was 615 p.s.i. (original pressure was estimated as 1400 p.s.i.). After 5 years of injecting gas into 2 wells, the average pressure had decline to 467 p.s.i. in the 13 wells. The average gas–oil ratio at start of injection was 2000 cu. ft/brl, and is now about 11,000 cu. ft/brl. The greatest operating problem, the channelling of gas, has been solved to a certain extent by controlling injection of gas by packers. It is estimated that recovery by gas injection ultimately will be 43·5% greater than primary operation for injection period, or 14·8% greater for entire life. A. H. N.

368. Practical Application of Geology to Reservoir Analysis. W. W. Wilson. *Petrol. Engr*, September 1946, **17** (13), 152.—Details are given of the history, stratigraphy, and structural geology of part of the Kanesholm Pool in McKean County, Pennsylvania. The use of this type of study in reservoir analysis is explained. The most important application is in determining the mobility of fluids within the reservoir. If the in-

dividual porous layers are areally extensive, and are of such physical character as to permit the free movement of fluids, reservoir forces may be determined from the observed fluid movements. However, the mode of deposition of a sand-producing formation can minimize the effect of the natural reservoir forces. In such cases, it may be impossible, without a detailed geological analysis, to determine the reason for the apparently anomalous reservoir behaviour. R. B. S.

369. Reservoir Performance and Well Spacing, Silica Arbuckle Pool, Kansas. L. F. Elkins. *Oil Gas J.*, 16.11.46, **45** (28), 201. (*Paper presented before A.P.I.*)—The Silica Arbuckle pool of Kansas, producing from the Arbuckle dolomite by water drive, provides one case history for study of the recovery mechanism and for intrapool analysis of the recovery–well-spacing relation for this important type of petroleum reservoir. Pool performance to date indicates no substantial difference in ultimate recovery efficiency directly attributable to increased average well density within the range of 10–40 acres/well in this pool. Tests in this pool show interferences within a few hours between wells as much as 1860 ft apart. Disagreement between the theoretical pressure reductions in a homogeneous reservoir and those measured in the produced and shut-in wells suggests the presence of high permeability streaks comprising a relatively small fraction of the total pore space. It is hypothesized that the recovery mechanism for this type reservoir is primarily that encroaching water gradually displaces oil from the less permeable channels through which oil flows into the wells. With this mechanism, the number of wells penetrating the same system of extremely permeable streaks should not greatly influence recovery from that part of the reservoir in communication with these streaks. This is in agreement with the recovery–well-spacing relation indicated by the over-all performance of the Silica Arbuckle pool. A. H. N.

370. Gas-Condensate Reservoirs. O. F. Thornton. *Oil Wkly*, 18.11.46, **123** (12), 42. (*Paper presented before A.P.I.* 12.11.46.)—Ten years of operation of gas-condensate reservoirs has verified the necessity for and practicability of co-operative and unitized operation. Three types of gas condensates are now recognized: wet-gas, retrograde-gas, and reservoir-liquid. The operating method for each reservoir should be based upon the characteristics of the gas condensate at reservoir conditions. Other factors such as richness of the gas, size of the reserve, capacities of wells, nature of the reservoir, and mode of occurrence of the gas condensate must be considered. Marketing conditions, tax position, and other factors are also important. Due to the increasing volume of the gas market, and prospects for chemical conversion of gas to liquid fuel by the Fischer–Tropsch process, many operators will be required to make a choice or compromise between complete pressure maintenance and gas sales. This can be done intelligently with known methods of evaluation. A. H. N.

371. Suspended Matter in Flood Water. Anon. *Oil Wkly*, 14.10.46, **123** (7), 61.—Suspended matter in flood water is present due to (1) being in the untreated raw water supply; (2) resulting from aeration; and (3) resulting from corrosion of pipelines in the distribution system. Suspended matter in the raw, untreated water supply being used for flooding operations is organic matter, sand, silt, other foreign matter, etc., and is usually referred to in water analysis as turpidity and colour. Suspended matter may be broken down into two classifications, as "sediment" which will rapidly settle out, and "turpidity" which slowly settles out. However, nearly all forms of suspended matter are usually referred to as turpidity. Colour of the water also is related to suspended matter in that it is almost invariably due to organic matter usually extracted from decaying vegetation. Methods of removal by aeration and coagulation are briefly described. A. H. N.

372. Oil Production by Water. Part 3—Oil Ahead of Water. P. J. Jones. *Oil Gas J.*, 16.11.46, **45** (28), 314.—Reservoirs have three dimensions and displacement of oil by water is in three dimensions. For production purposes, it is convenient to replace the structural and stratigraphic characteristics of reservoirs by a factor called convergence of reserve. Convergence is a number which combines structure and pay thickness. The limiting values are zero and two. In the vicinity of an injection well, convergence is equal to zero. For a uniform distribution of pay, convergence is equal to unity.

Along the crest of a reservoir, convergence is equal to two. The oil displaced ahead of water, aside from expansion, varies with the fluid factor, convergence and the distance advanced by water before reaching producing wells. A. H. N.

373. North Texas Water-Flooding Possibilities. A. Gibbon. *Oil Wkly*, 28.10.46, **123** (9), 47.—A summary of the findings of the U.S. Bureau of Mines in studying the water-flooding practices of North Texas is presented and discussed. The history of various fields and projects is briefly indicated. One company operating two adjacent projects used two types of well spacings: a five-spot and a nine-spot pattern. In the five-spot pattern project with like wells spaced at 300-ft intervals, the response to water injection was relatively rapid and the peak of oil production was attained after approximately 14 months. In the case of the nine-spot pattern the oil-producing wells were drilled at 300-ft intervals with the centre well of each group of nine serving as a water-injection well. Response to water injection was much slower than on the five-spot pattern project, and peak oil production was not attained until after 2½ years from the inception of water injection.

The open-type systems and the methods of water-treatment are described. Production data are presented graphically. A. H. N.

374. Flowing Water-Flood Production. T. F. Lawry. *Oil Wkly*, 18.11.46, **123** (12), 54. (*Paper presented before A.P.I.* 12.11.46.)—Flowing of water-flood production was attempted very early in the Bradford field, Pa, but did not become popular until the development of water flooding in the shallow Mid-Continent fields. The advantages of flowing over pumping lie in the simplicity of operation, and economy of first cost, as well as of operation. Flowing is used mainly in the shallow water-flood operations in the Mid-Continent sands, in which permeability and viscosity do not seriously retard the injection of sufficient water volume. The experience with flowing to date has been such that there seems to be no difference in the ultimate recovery of water flooding—whether by flowing or by pumping. A. H. N.

375. Salt-Water Disposal. W. S. Morris. *Oil Gas J.*, 31.8.46, **45** (17), 92.—In this, the concluding article of a series dealing with East Texas water disposal projects, data on the production of oil and water and the quantities injected are presented and discussed. A. H. N.

376. Construction and Calibration of Sun Permeameter. A. B. Long. *Oil Wkly*, 28.10.46, **123**-(9), 44.—The construction, calibration, and use of an instrument to measure the permeability of rock samples to air are described. Flow is maintained under constant pressure differential and the manometer of an orifice on the outlet is calibrated directly in millidarcys. A. H. N.

377. Salt Quickly Cleans Flow Lines. L. N. Scheuermann. *Oil Wkly*, 11.11.46, **123** (11), 57.—It is found that salt of the variety known as "ice-cream salt" is useful in clearing paraffin deposits from oil lines. Insoluble in oil and readily soluble in water, salt is introduced as a mechanical abradant in entrainment with the oil in the line where it acquires sufficient momentum to cut the paraffin in a mechanical manner. The minimum flow pressure is about 130 p.s.i. If the pressure is less, it can be built up by taking pressure from another well or by using a pump. One advantage of using salt is that if any accumulation results from combinations of the paraffin and abrasive, the abrasive can be dissolved out by circulating water through the flow lines to release the pack-up. However, in over 2000 tests, no pack-up has occurred. Salt has the following properties which are necessary to remove hydrocarbon deposits: (1) Crystalline form and not too fine; (2) Sufficient hardness; (3) Insolubility in petroleum oil; (4) Solubility in water; (5) Non-poisonous; (6) The general properties of not reacting with oil or water; (7) Non-injurious to equipment or personnel. Equipment for injection of the salt is described. In general, a by-pass is installed and the line-oil is used to inject the salt from a pipe or a hopper into the main-line. A. H. N.

378. Laboratory for Production Problems. R. Sneddon. *Petrol. Engr*, September 1946, **17** (13), 178.—A brief description is given of the Shell Oil Company's recently

completed production laboratory in Los Angeles. The contemplated programme of research is also outlined. R. B. S.

379. Engineering Developments in Southwest Texas. J. W. Crutchfield and H. T. Pruett. *Petrol. Engr*, October 1946, **18** (1), 208.—The most important engineering developments in this region have been connected with well completions and with problems connected with reservoir engineering. These developments are briefly discussed. R. B. S.

Oilfield Development.

380. Argentine Petroleum Industry (1). A. Landoni and A. Zanetta. *Petroleum*, 1946, **9** (11). (*From the "Historia del desarrollo de' la industria petrolera en el pais" published in "La Ingenieria,"* 1945, **49**, 646–662.)—A historical review of the origin and development of the Argentine petroleum industry, including statistics of crude oil production and drilling. K. C. G. K.

381. Argentine Petroleum Industry (2). A. Landoni and A. Zanetta. *Petroleum*, 1946, **9** (12), 288.—The second part of an article dealing with exploring and drilling for oil in Argentina. K. C. G. K.

382. Search for Petroleum in Bahia (Brazil). A. I. de Oliveira. *Bol. del Inst. Sud-americano del Petroleo*, 1946, **2**, 449–470.—Details of exploratory drilling in the State of Bahia, with maps and geological formations. The estimated reserves in the four fields covered are 7 million brl, with more than 1 billion cu. m. of gas. A. C.

Transport and Storage.

383. Tank Ships. B. Saurino. *Oil Gas J.*, 28.12.46, **45** (34), 160.—A review is given of the world tanker position to-day.

World fleet capacity increased 66% during the war. The U.S. owns 62·3% of the world tonnage to-day compared with 23·9% owned on September 1, 1939, whilst Great Britain owns 16·2% which is within 5% of her pre-war figure. Total world tonnage amounts to 21½ million deadweight tons, as compared with 13 millions at outbreak of war. The U.S. owns 13½ million tons of present total.

The 1947 building programme shows 118 vessels under construction, mostly in Great Britain (52), Denmark (11), and Sweden (32). Only 2 are being built in the U.S.

Tables show world tank-ship fleets by flag as at January 1947, ships under construction or on order, the U.S. privately-owned tanker fleet as at January 1947, and average tanker charter rates for clean and dirty tonnage from U.S. to North Atlantic ports annually from 1928 to 1946. It is concluded that operating costs in the foreseeable future will remain at higher than previous levels, and that privately-owned tankers under U.S. flag can meet current domestic transportation if the big-inch lines are utilized for shipping liquid products from the Gulf Coast. G. A. C.

384. A Case Study in the Transportation of Natural Gas. J. E. Flanders. *Pipe Line News*, September 1946, **18** (9), 5.—A hypothetical example is discussed in detail to illustrate the marked effect which load factor has on the cost of transporting natural gases. The operating expenses taken into account in the discussion are those of: (1) compressor station operation, (2) compressor station maintenance, (3) measuring station operation and maintenance, (4) communication system operation and maintenance, (5) fuel, (6) gas losses, (7) sales, and (8) general overheads. R. B. S.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

385. Air Compressor Operation. D. Attaway. *Refiner*, 1946, **25**, 282.—Safe practices in air compressor operation are discussed shortly under explosion hazards, location and foundation, capacities, compressor lubrication, decomposition of oil, carbon

deposits, clear air at intake cooling water, fusible plugs, discharge piping, air receivers, working pressures, air-starting piping, and personal protective devices. G. R. N.

386. Fundamental Factors in Corrosion Control. H. H. Uhlig. *Chem. Eng. News*, 1946, **24**, 3154.—The author has surveyed the various methods of corrosion control and discussed the principles underlying them. Items dealt with are cathodic protection, metallic and organic coatings, inhibitors and passivators, corrosion-product coatings, effect of alteration of environment, influence of impurities in metals on their rate of corrosion, improvement of chemical resistance by alloying (stainless steels), and finally methods of achieving high temperature resistance for both the lower and upper zones of the high temperature range. The article is well illustrated with diagrams.
L. B.

387. Plate Efficiency of Fractionating Columns and Absorbers. H. E. O'Connell. *Trans. Amer. Inst. Chem. Engrs*, 1946, **42**, 741.—A correlation of plate efficiency as a function of feed viscosity and the relative volatility of key components has been developed for fractionating towers from tests data on 29 commercial columns and 5 laboratory columns previously reported in the literature and from new test data on 3 commercial columns not previously reported. Also, the correlation of Walter and Sherwood for laboratory plate absorbers, which expresses plate efficiency as a function of viscosity and Henry's law constant, has been simplified and compared with the efficiency for commercial absorbers. The correlations are suitable for determining the plate efficiency in the design of commercial fractionating columns and absorbers.—(Author's abstract.)

388. Furnace Tube Decoking with Steam and Air. H. Bottomley. *Refiner*, 1946, **25**, 377.—A short account of the removal of coke from furnace tubes by means of air and steam injection through the hot tubes with reference to the mechanics of the operation and the furnace temperature. The economics of this method are partially enumerated as (1) Reduced downtime when furnace cleaning is the delaying factor; (2) Reduction in man hours for tube cleaning; (3) Elimination of tool maintenance and repair; (4) Increased tube life; (5) Increased ease of tube and header inspection; (6) Elimination of tube turbining mess and noise. G. R. N.

389. The Effect of Heat Loss on the Performance of Exchangers with Interconnected Walls. P. R. Trumpler. *Trans. Amer. Soc. Mech. Engrs*, 1946, **68**, 487.—Equations are devised for the calculation of exchangers in which the passage walls are bonded to each other, providing substantially uniform wall temperature over any cross section normal to the flow. Results are presented for both countercurrent and cocurrent exchangers and an example illustrating the solution is given.—(Author's abstract.)

390. The Influence of Viscosity on Centrifugal Pump Performance. A. T. Ippen. *Trans. Amer. Soc. Mech. Engrs*, 1946, **68**, 823.—In order that the performance characteristics of centrifugal pumps for use in the oil industry could be predicted with a reasonable degree of certainty, an experimental study of the behaviour of various designs of pump was undertaken. The fluids used were water and oils with viscosities up to 10,000 s.s.u. Experimental results are given and the influence of points in pump design on performance with fluids of various viscosities is analysed and discussed.
A. R. J.

391. Pilot Plant and Commercial Desalting. M. J. See, J. P. Lindahl, H. R. Taliaferro, and C. R. Harte, Jr. *Refiner*, 1946, **25**, 463.—Desalting measures were necessary when S.O.C. Indiana at Whiting commenced refining West Texas crude containing up to 300 lb salt/1000 brl. Four desalting units of the coalescer and settling type are in operation. The process consists essentially of mixing a small amount of water with the crude, heating the mixture to about 230° F, coalescing by means of an excelsior bed and settling at a pressure sufficient to prevent vaporization. A demulsifying chemical is employed. The treated crude has an average salt content of about 30 lb./1000 brl. Pilot plant work has indicated with excelsior as the coalescent that with increased water addition it may be possible to obtain satisfactory desalting without a

demulsifier: since the cost of this chemical is an important item attractive savings may be possible. Pilot plant runs on the use of glass fibres as the coalescent have given crudes of salt content around 10 lb/1000 brl with a satisfactory life of the medium. A full-scale programme is under way to compare the two coalescing mediums.

G. R. N.

392. Process Pumps for Oil Refineries and Similar Plant. W. F. Riester. *Petrol. Times*, 26.10.46, **50**, 1110.—An account is given of the requirements of pumps for oil refinery service and the importance of suction performance is stressed. Recent developments which have been responsible for the design of pumps giving better performance in oil refinery plant are described. R. B. S.

393. Thermal Conductivity. The Refiner's Notebook No. 124. W. L. Nelson. *Oil Gas J.*, 21.12.46, **45** (33), 87.—A table and a graph are given from which the thermal conductivity of the various materials, used in refineries, may be obtained for use when determining the following: (1) the heat losses in furnace walls, pipe insulating materials, etc., (2) the heat transfer coefficients of liquids or gases, and (3) the thermal resistance of dirt or coke layers on exchanger and pipe-still tubes. W. H. C.

394. Losses through Heated Walls. The Refiner's Notebook No. 125. W. L. Nelson. *Oil Gas J.*, 4.1.47, **45** (35), 77.—An equation is given for computing the loss of heat by conduction through flat walls or surfaces. The factors that affect the film coefficient are described, viz. the temperature of the surface in contact with the air, the air velocity and the position of the surface (vertical, horizontal upper or lower, or sloping) and factors for them are given. The most troublesome factor is the temperature difference between the wall and the air, but the difficulty of this trial-and-error computation can be eased by the use of the chart presented. The composition of the chart is described and an example of its use is shown. W. H. C.

395. Electric Power in Oil Refining. W. H. Stueve. *Oil Gas J.*, 21.12.46, **45** (33), 73. (*Paper presented before the Petroleum Electric Power Assoc., Tulsa.*)—Data relative to electric power, both purchased and refinery generated, used at U.S. refineries for the year 1929, 1939, and 1944 are shown and discussed and compared with the consumption of electricity in all U.S. manufacturing industries, and a survey of the electric and mechanics power used at 44 U.S. refineries in 1937 is given. It is shown that (*a*) in 1939 the use of electricity increased over 10 years from 1·78 to 3·18 Kw-hr/brl; (*b*) in 1937 the ratio of purchased to generated electricity was 1·58 : 0·64 Kw-hr/brl, and (*c*) to-day, refineries are 54% electrified. The trends are towards (1) the use of all electric motors for new applications and also a change from obsolete steam-driven equipment to motors, and (2) a larger use of purchased electricity, despite the fact, as shown later, that refinery generation is far cheaper. The reason appears to be that less L-P steam is required for process work than would be produced if all the electricity requirements were refinery generated by the use of H-P steam. Refinery generation, both of steam and electricity, is discussed from several aspects, and costs, capital expenditure, and amortization are given and compared with cost of purchased power. W. H. C.

396. Reclamation of Waste. J. L. Heath and P. Giblin. *Refiner*, 1946, **25**, 443.—Major sources of waste treated at Magnolia's Beaumont refinery are classified as (1) Oil rejected from treating units or refinery spillage; (2) B.S. and W. from crude oil tanks; (3) Oil displaced from pipelines to avoid contamination caused by pumping different products; (4) Refuse from tank cleaning operations; and (5) Oil present in waste treating reagents. These materials are gathered in an integrated system of sewers and settling tanks or ponds. To remove the maximum quantity of water before final demulsification some materials are handled differently from others. Materials classified in the first and third groups are transferred to the inter-refinerys eparators where some water is removed by settling. Materials in group 2 are pumped directly into the emulsion-breaking tanks. Groups 4 and 5 which contain large vols. of water are first transferred to the waste oil settling ponds. Final reclamation is carried out in emulsion-breaking tanks on a 48-hr operating cycle where the emulsion is heated to 120–150° F and treated with boiler blow-down and spent caustic. After 24 hr settling water and

sludge are withdrawn from the bottom and clean oil from the top, leaving an emulsion in the tank to go forward to the succeeding cycle. G. R. N.

Distillation.

397. Deposits Formed in the Refining Process. L. F. Shimansky. *Riv. ital. Petrol*, November 1946, **163**, 13.—The problem of the gummy deposits formed in the heating of the crude in refining is reviewed. It is linked up with the dissolved oxygen content of the crude, and examples are given of how the amount of deposit is diminished by various methods of cutting down this oxygen content. D. H. McL.

398. Operating Characteristics of Hypercal Fractionating Columns. P. L. Brandt, R. B. Perkins, and L. K. Halverson. *Oil Gas J.*, 7.12.46, **45** (31), 86.—The operation and performance of commercially available Hypercal Laboratory Fractionating Columns having a 25 mm by 36 in Heligrid packing is described.

Two types of columns were studied, the only difference being in the reflux control head. The Podbulniak-designed head is built directly within the vacuum jacket that insulates the column; the Shell-designed liquid-dividing head is a tipping bucket type, permitting the use of thermometers for vapour-temperature measurements. Still pots used are standard round-bottom flasks, heated with Glas-Col mantles. Boil-up rate control normally is manual.

The test liquid was a mixture of *n*-heptane and methyl*cyclo*hexane.

A series of tests show that the 25 mm diameter by 36 in long section of Heligrid packing is equal to the best of the small column packing. The equivalent of 90 theoretical plates and a hold-up of 0·36 ml per theoretical plate are obtainable at 500 ml per hr boil-up rates. Fractionating efficiency falls off with increasing boil-up rate; the theoretical plate value is 48 and hold up 1·07 ml per plate at 2000 ml per hr. An average of 8 hr is required at total reflux to attain equilibrium.

Distillation data at 100 : 1 reflux ratio are presented for comparison with operation of other columns. G. A. C.

Absorption and Adsorption.

399. Absorber Operating Efficiency. E. G. Ragatz and J. A. Richardson. *Refiner*, 1946, **25**, 582.—The Kremser–Brown theoretical absorption tray analysis shows weakness in that its basic tray efficiency factor shifts markedly in value with percentage of key component recovered. The degree of this shifting varies widely for different columns and for different conditions of operation of a given column. Since it is rarely possible to operate a commercial column under an exact pre-set condition of feed quality, column loading, and key-component recovery this shifting of the tray efficiency drastically limits the usefulness of the conventional analysis for accurate specification definition or for precise column operation comparison. Recently, an analysis has been made of the operating characteristics of 40 commercial columns ranging in pressure from 30 to 1800 lb gauge From this a technique has been developed to evaluate absorber performance which utilizes an experimentally derived absorption factor chart which gives promise of fully correcting the limitations of the conventional Kremser–Brown method. G. R. N.

Cracking.

400. Automatic Control of a Fluid Catalytic Cracking Unit. M. MacDonald. *Refiner*, 1946, **25**, 471.—A simplified account with diagrams of the various controls necessary to operate the unit. 88 controllers and 54 recorders are required. G. R. N.

401. Fluid Catalyst Technique. L. S. Daniels. *Refiner*, 1946, **25**, 435.—A comprehensive account of the mechanical operations involved in the catalyst section of the fluid catalytic cracking process. Heat balances, auxiliary catalyst equipment, and calculations on fluid catalyst circulation systems are given. G. R. N.

402. Hydrogen Sulphide Removal from Cracked Gas. Anon. *Refiner*, 1946, **25**, 505.—Dubbs gas at Fletcher Oil Co., Wilmington, California, contains 2500 grains H_2S per 100 cu. ft. This is reduced to 15 grains per 100 cu. ft by washing the gas in an

absorber type column with diethanolamine. The spent reagent is regenerated and disposal of H_2S is by burning. G. R. N.

403. Improved Houdry Reactor Design. R. C. Lassiat and C. H. Thayer. *Refiner*, 1946, **25**, 453.—A major improvement in the Houdry catalytic cracking process, resulting in both lower operating costs and increased gasoline production, has been effected by re-designing the reactor tubes and changing the physical composition of the catalytic mass. The effect of these changes is discussed. G. R. N.

404. Commercial T.C.C. Operations. H. D. Noll, A. W. Hoge, and D. M. Luntz. *Refiner*, 1946, **25**, 599.—The T.C.C. unit at Paulsboro (Socony Vacuum) has operated satisfactorily since March 1946 with concurrent flow of catalyst and oil through the reactor charging both vaporized and partially vaporized stocks. During this period the vapour–catalyst disengager (necessary for concurrent flow) functioned efficiently, steam purging of the spent catalyst was accomplished more easily than on counter-current flow, and distribution of the liquid and vapour charge through the reactor bed was uniform. There was better utilization of the heat content of the inlet catalyst and oil streams giving higher average reactor temperatures which resulted in higher octane no. gasolines. Carry over of catalyst fines to the synthetic crude was negligible, while there was no abnormal break-up of catalyst. Cost of conversion of a unit from counter to concurrent flow is about 1% of the initial investment. G. R. N.

405. Earnings—A Function of Catalyst Activity. R. E. Bland and E. A. Smith. *Refiner*, 1946, **25**, 383.—Catalyst loss is the quantity of catalyst mechanically lost from a system. Catalyst make up is the sum total of catalyst added to a system to make up mechanical losses plus catalyst added to the system (balanced by physical catalyst withdrawal from the system) to maintain optimum catalyst activity. For example, T.C.C. units will operate on clay catalyst with a mechanical loss of 0·1 lb/brl. It is shown, however, that to maintain optimum catalyst activity from the economic standpoint equilibrium catalyst should be withdrawn from the system and replaced with additional fresh make-up. In the case of a 10,000 brl/day T.C.C. unit the total optimum catalyst replacement is indicated to be 0·8 lb/brl for maximum profit. G. R. N.

406. Largest Unit of Kind in World. R. Maass and R. A. Lauterbach. *Oil Gas J.*, 4.1.47, **45** (35), 45.—The delayed coking-plant of the General Petroleum Corp., at Torrance is fully described and shown by seven illustration and a flow diagram. The cracking portion of the unit is divided into two sections, each with its own furnace and a pair of coke drums to be used alternately. For the delayed coking operation the furnaces are designed for a high rate of heat transfer, and contain four separate coils in the radiant section, the charge first entering the hottest part of the convection section. The outlets from the radiant section flow by a common transfer line to the fractionator. The cooler portion of the convection section contains water-coils for providing process steam. Decoking is done every 24 hr and involves the use of a rotary boring-tool having water-jets, of different sizes for the operations of boring, reaming, and cutting out of the coke in the 80 × 17 ft drums. This tool is illustrated and its working, and the blowing-down operation of the full drum before boring, etc., are fully described. The operating conditions are: Reduced crude charge, 15,000 brl/day Furnace charge; 20,000 brl/day, Recycle: fresh feed ratio 0·33. The temperatures used are: Furnace outlet, 920° F; Drum inlet and outlet, 900 and 830° F, respectively, at 56 p.s.i. The yields from 700 sec, Saybolt Furol viscosity at 122° C reduced crude are: Total gas, 14·0% (wt), Raw B.B. liq vol 0·8%, Debutanized gasoline, 22·5% (vol), Light gas oil, 36·5%, Medium gas oil, 16·7%, Coke, 19·1% (wt). W. H. C.

Chemical and Physical Refining.

407. Recovery of Volatile Solvents in Industry. G. Tartarani. *Chim. e Industria*, 1946, **28**, 7–8, 117.—The fundamental characteristics of the adsorption of gases and vapours by activated carbon and the other solid adsorbents most used in industry are summarized. The optimum conditions for obtaining the maximum efficiency for a given

adsorbent are examined. Finally, an investigation is made of the more important industrial processes used in Europe for solvent recovery, together with a parallel summary of modern requirements which have become apparent in recent years as a result of great industrial development. D. H. McL.

Special Processes.

408. Air Oxidation of High Molecular Weight Petroleum Hydrocarbons. H. W. Zabel. *Chem. Ind.*, November 1946, **59**, 821.—Contrary to the general opinion that this process has been operated for any length of time in Germany alone, it has been used in America since 1926 though there, apart from the production of certain aldehyde fractions, for denaturing ethyl alcohol, it did not progress to commercial scale until the demand for lubricating oil dopes provided a major continuous market.

The type of feed-stock for the process (highly paraffinic hydrocarbons with boiling points ranging from gasoline to petroleum waxes) is determined by the nature of the product required, and the oxidation is carried out at 200–350° F. To initiate the reaction the presence of heavy metal soaps, or high molecular weight ketones or alcohols, is required. The off-gas contains water, carbon dioxide, and nitrogen, with formic, acetic, and other low boiling fatty acids.

After the oxidation is completed, the product is neutralized with caustic soda and the mixture of alcohols and ketones can be drawn off from the surface of the oil for use as an anti-corrosion agent or for subsequent sulphation and sulphonation to give surface-active agents. The water-insoluble fatty acids are isolated from the soap solution, or they can be esterified to give lubricating oil additives or, since they have a low vapour pressure, they may be useful as plasticisers. The amine salts of these acids are effective defoaming flotation agents.

The alkaline-earth soaps are used in preservative oils and are prepared in the oil medium from the sodium soaps by treatment with aqueous solutions of alkaline-earth salts. They are stored in solution in oil after filtration to remove oil insolubles. Heavy metal soaps can be prepared similarly for use as cloth impregnants and gelling agents for fuels and lubricants. Large quantities of the hot oxidized hydrocarbon products are used in the manufacture of dispersed metal soaps for control of corrosion. O. M.

409. Fischer–Tropsch Process: Present and Future. C. C. Hall. *Engineering*, 10.1.47, **163**, 30.—Considering German progress with this process, it is suggested that it would be uneconomic to operate in Britain without first effecting either a reduction in the cost of the synthesis gas or an improvement in the efficiency of the process. A short historical survey is given in which it is pointed out that during the war the process yielded only 8% of Germany's home oil production compared with 45% produced by high-pressure hydrogenation of coal and tar. At present the greatest use of the process is producing raw material for the chemical industry. The article, which is to be continued, describes the process and compares the relative efficiencies of brown coal and coke for production of the synthesis gas. G. P. K.

410. Hydroforming for Production of High-Octane Motor Fuel. L. R. Hill, G. A. Vincent, and E. F. Everett. *Trans. Amer. Inst. Chem. Engrs*, 1946, **42**, 611.—Published data on hydroforming to produce automotive gasoline are meagre because half the plant capacity was built since 1941, and all of the plants were used during the war for the production of toluene and aviation-gasoline blending components.

The hydroforming process converts low-octane naphthas into stable, high-octane motor gasoline by means of dehydrogenation and cyclization. These reactions are promoted by a molybdena-on-alumina catalyst at temperatures of 900–1000° F and pressures of 150–300 p.s.i. gauge, with a high partial pressure of hydrogen in the reaction zone. Hydrogen is one of the products of the reaction, which makes it possible to maintain a high hydrogen concentration in a gas stream which is recycled to the reactor along with vaporized feed.

Hydroforming is carried out in a unit having four reactors filled with catalyst, two of which are always in series on reaction and two in different stages of regeneration. The reactors are switched from reaction through several regeneration steps and back to reaction in cycles of 8–16 hr duration by an electric cycle-controller. Regeneration is

necessary because a small deposit of carbon and a partial reduction of the metal in the catalyst combine over a period of hours to reduce the activity of the catalyst. When charging naphthas of high sulphur content, a gradual sulphiding of the catalyst also contributes to the loss of activity. The carbon is burned and the catalyst re-oxidized by combustion in a stream of air greatly diluted by cooled and recirculated flue gas.

The reaction products are recovered and fractionated in a 4-tower fractionating system which has as its products: (1) a hydrogen-containing gas substantially free of hydrocarbons heavier than propane, (2) a highly aromatic " polymer " boiling above 400° F, and (3) a depropanized, 400° F E.P. gasoline.

Hydroformer gasolines are characterized by a very low olefin content; a similarly low content of sulphur compounds, even when a sulphur-bearing naphtha is charged; low Reid vapour pressures; high clear O.N.; high lead susceptibilities.

Yields of 78–80 vol % of 80 CFR-M octane, 100% C_4 recovery gasoline are obtained, with the balance of the material going approximately three-fourths to C_4-free gas and one-fourth to polymer and carbon. When operating to lower octane levels it is possible, by blending in extraneous butanes to raise the vapour pressure of the finished gasoline, to obtain a yield, based on feed, of 100% of 68·8 octane gasoline which can be brought up to 80 CFR-M octane by the addition of 1·5 c.c. of TEL.—(Author's abstract.)

411. The Isomate Process. J. E. Swearingen, R. D. Geckler, and C. W. Nysewander. *Trans. Amer. Inst. chem. Engrs*, 1946, **42**, 573.—The Isomate process is a method of converting low O.N. pentanes and hexanes into isomers of higher O.N. and volatility. A liquid aluminium chloride-hydrocarbon complex promoted with anhydrous HCl is used as a catalyst, and hydrogen is added to repress cracking and maintain high catalyst activity. Conversion is accomplished by passing liquid hydrocarbon charge in a dispersed phase through the catalyst complex. Preferred reaction conditions are 240–250° F and 700–800 p.s.i.

In a one-pass operation Isomate of about 80 CFR-M unleaded O.N. can be produced; and by separation and recycling of low O.N. pentanes and hexanes, a product of about 91 unleaded O.N. can be produced. Liquid yields are essentially 100%. Plants of 5000 brl per stream day and 1750 brl per stream day capacity have been constructed and successfully operated at Whiting, Ind., and Salt Lake City, Utah.—(Author's abstract.)

412. The Shell Vapour-Phase Isomerization Process for the Production of Isobutane. H. A. Cheney and C. L. Raymond. *Trans. Amer. Inst. chem. Engrs*, 1946, **42**, 595.—This paper describes a process for the catalytic conversion of normal butane to *iso*-butane. The isomerization catalyst consists of anhydrous aluminium chloride adsorbed on a granular alumina support. Anhydrous hydrogen chloride is used as the catalyst promoter. The reaction is carried out in the vapour phase at from 200° to 300° F, and under a pressure of from 150 to 260 p.s.i. gauge at average conversion levels of 40–45%.

A flow scheme is given, operation of the process is explained, and the manufacture of the catalyst from a natural alumina and aluminium chloride is described. The effects of the chief reaction variables and of various impurities which might be found in the normal butane feed are discussed. Average operating data are given for three plants covering a six-months' period.—(Author's abstract.)

413. Isomerization of Light Hydrocarbons. Stephen F. Perry. *Trans. Amer. Inst. chem. Engrs*, 1946, **42**, 639.—This paper describes processes for the conversion of normal butane to *iso*butane and of normal pentane to *iso*pentane, which were developed co-operatively by the Anglo-Iranian Oil Co. and the Standard Oil Development Co. The essential features of both processes include: (1) the use of a highly selective solid catalyst, namely, $AlCl_3$ adsorbed on bauxite, and (2) a technique for maintaining the activity of the catalyst by the introduction of fresh $AlCl_3$ along with the feed.

Butane isomerization plants utilizing the process described in this paper have been built in sizes ranging from 600 to 3600 brl of *iso*butane per day, the combined capacity amounting to about 25,000 brl per day. A typical plant is described in detail. Several of the plants were constructed almost entirely from existing equipment, with a substantial saving in time and critical materials, when the wartime need for *iso*butane

was most pressing. Plant performance data and the major operating difficulties encountered and overcome are discussed.—(Author's abstract.)

Metering and Control.

414. Instrument–Air–Supply Systems. W. C. Ludi. *Refiner*, 1946, **25**, 478.—An outline is given of present practice in the design of instrument–air–supply systems for process units. These systems are important in plants using automatic control instruments since continuous satisfactory performance is essential to the production of specification products and the maintenance of operator morale. For design purposes basic engineering data are given on pressure requirements and instrument–air consumption. Also included is a discussion of instrument–air drying methods and systems and notes on the principal design features desired in the mechanical equipment.
G. R. N.

415. Pulsation and Its Effect on Flowmeters. E. J. Lindahl. *Trans. Amer. Soc. Mech. Engrs*, 1946, **68**, 883.—Errors in flowmeter readings can be caused by pulsations in the fluid which is being measured. This type of error is dealt with and methods for reducing its severity are given. A. R. J.

416. Dynamic Behaviour and Design of Servo Mechanisms. G. S. Brown and A. C. Hall. *Trans. Amer. Soc. Mech. Engrs*, 1946, **68**, 503.—A mathematical treatment is given of the factors influencing the design and the satisfactory working of servo-mechanisms when used for various purposes. A. R. J.

Patents.

417. Patents on Refining Processes and Products. R. E. Burk, assr to S.O.C. Ohio. U.S.P. 2,400,874, 28.5.46. E. C. Hughes and J. D. Bartleson, assrs to S.O.C. Ohio. U.S.P. 2,400,875, 28.5.46. Recovery of boron trifluoride catalyst from admixture with hydrocarbons by absorption in dimethylaniline or diphenylamine under suitable conditions.

W. O. Keeling and W. L. Glowacki, assrs to Koppers Co. Inc. U.S.P. 2,400,883, 28.5.46. Purification of benzol by crystallization and centrifugation.

B. L. Evering and E. L. d'Ouville, assrs to S.O.C. Indiana. U.S.P. 2,400,922, 28.5.46. Aviation gasoline components are obtained from light paraffinic hydrocarbons by the following processes: production of hydrogen by the action of steam on the light gaseous fraction, production of polymer from the heavy gaseous fraction then hydrogenation of the polymer, isomerization of the light liquid fraction in the presence of hydrogen.

B. L. Evering and A. P. Lien, assrs to S.O.C. Indiana. U.S.P. 2,400,985, 28.5.46. V. Voorhees, assr to S.O.C. Indiana. U.S.P. 2,400,986, 28.5.46. Hydrofluoric acid is employed to desalt crude petroleum.

H. L. Cupples, assr to U.S.A. U.S.P. 2,401,053, 28.5.46. An apparatus to determine the surface tension of an unknown liquid by the method of maximum bubble pressure.

O. M. Reiff and J. D. Zech, assrs to Socony Vacuum Oil Co. U.S.P. 2,401,104, 28.5.46. A plastic oxy-aromatic petroleum wax is obtained by heating a chlorinated petroleum wax with phenol or naphthol or diphenyl ether in the presence of a Friedel–Crafts catalyst then dechlorinating with caustic soda.

W. A. Schulze and G. H. Short, assrs to Phillips Petroleum Co. U.S.P. 2,401,114, 28.5.46. Low-boiling diolefins are separated from hydrocarbon mixtures by absorption on dry powdered cuprous halide.

M. Berliney, G. A. Bowden, and J. T. Hohnstine, assrs to Boyle–Midway Inc. U.S.P. 2,401,217. A wax coating composition consisting approximately of 73% paraffin wax, 18% ester type rosin, and 9% stearic acid.

W. Hull, assr to American Cyanamid Co. U.S.P. 2,401,246, 28.5.46. A monocyclic terpene is converted to *p*-cymene in the presence of a supported oxide catalyst.

E. M. Nygaard, assr to Socony Vacuum Oil Co. U.S.P. 2,401,267–9, 28.5.46. The preparation of nitrolic acids and pseudonitroles from mononitroparaffins.

O. M. Reiff and D. W. Andrus, assrs to Socony Vacuum Oil Co. U.S.P. 2,401,273, 28.5.46. An additive for a viscous oil comprising an oil-soluble metal hydrosulphide of a basic polyvalent-metal salt of an alkyl substituted aromatic hydrocarbon compound.

C. E. Welling, assr to Phillips Petroleum Co. U.S.P. 2,401,282, 28.5.46. Methanol is used as the azeotropic liquid in the separation of *cyclo*pentene from piperylene.

R. E. Burk and E. C. Hughes, assrs to S.O.C. Ohio. U.S.P. 2,401,334, 4.6.46. Naphtha is desulphurized by contact with a spent Cr_2O_3,Al_2O_3 catalyst then aromatized with a fresh charge of new catalyst.

H. H. Meier, assr to S.O. Dev. Co. U.S.P. 2,401,363, 4.6.46. A combined catalytic and thermal cracking process to produce aviation gasoline base.

C. E. Welling, assr to Phillips Petroleum Co. U.S.P. 2,401,444, 4.6.46. Acetylene is removed from a gaseous mixture containing olefins by hydrogenation in the presence of borosilicate glass.

V. L. Chechot and L. S. Howe, assrs to Atlantic Refining Co. U.S.P. 2,401,614, 4.6.46. Before removing solid material from an oil solution of an alkaline earth metal sulphonate a small amount of an aliphatic alcohol, glycol, or glycol ether is added to reduce the viscosity.

V. Haensel and V. N. Ipatieff, assrs to U.O.P. Co. U.S.P. 2,401,636, 4.4.46. The olefin content of an unsaturated gasoline is reduced by the action of a precipitated silica–alumina catalyst under suitable conditions.

F. W. Leffer, assr to U.O.P. Co. U.S.P. 2,401,649, 4.6.46. A multi-stage process including reforming, alkylation, and catalytic olefin conversion to convert non-aromatic oil into low-boiling aromatics.

G. B. Zimmerman, assr to U.O.P. Co. U.S.P. 2,401,678, 4.6.46. A recycle process for isomerization of *n*-butane.

L. H. Flett and G. C. Joone, assrs to Allied Chemical and Dye Corpn. U.S.P. 2,401,726, 11.6.46. A detergent composition containing an alkali-metal salt of a long chain (12–18 C atoms) monoalkyl ester of sulphuric acid and a water soluble salt of a monoalkyl ester of sulphoacetic acid.

A. D. Green, assr to S.O. Dev. Co. U.S.P. 2,401,754, 11.6.46. A process of finishing solid high mol. wt. polymers prepared from an *iso*olefin at below — 40° C in the presence of a Friedel–Crafts catalyst.

S. H. Hastings and B. B. Turner, assrs to S.O. Dev. Co. U.S.P. 2,401,758, 11.6.46. Acetylene is removed from its mixture with diolefins by dehydrogenation in the presence of a diluent.

H. S. Taylor and J. Turkevich, assrs to M. W. Kellogg Co. U.S.P. 2,401,802, 11.6.46. Mono-olefins are converted to diolefins by contact at an elevated temperature with a granular alumina catalyst having deposited thereon an oxide of metal of the left-hand column of groups IV, V, and VI of the periodic table in a non-oxidizing atmosphere containing steam.

S. D. Sumerford, assr to S.O. Dev. Co. U.S.P. 2,401,846, 11.6.46. A method of activating the catalyst with steam and a gaseous paraffin prior to catalytic dehydrogenation of olefins.

G. B. Arnold and H. V. Atwell, assrs to The Texas Co. U.S.P. 2,401,852, 11.6.46. Aromatics are extracted from a straight or cracked naphtha using water containing up to 25% of ammonia or aliphatic amines at 300–450° F under pressures up to 1300 lb.

L. A. Clarke, assr to The Texas Co. U.S.P. 2,401,859, 11.6.46. A multi-stage process of manufacture of gasoline including polymerization, alkylation, and isomerization.

M. H. Gorin, E. Gorin, L. G. Sharp, and I. H. Welensky, assrs to Socony Vacuum Oil Co. U.S.P. 2,401,865, 11.6.46. An olefin and a light *iso*paraffin are converted to high octane-number hydrocarbons by contact with a catalyst comprising an association

of an acidic oxide and an amphoteric oxide at 275°–500° C at a pressure in excess of 100 lb.

J. P. Jones, assr to Phillips Petroleum Co. U.S.P. 2,401,872, 11.6.46. A multi-stage process for converting ethane to butadiene.

W. A. Schulze and W. N. Axe, assrs to Phillips Petroleum Co. U.S.P. 2,401,884, 11.6.46. Treatment of boron fluoride catalysts prior to use in alkylation.

W. C. Asbury and M. W. Swaney, assrs to S.O. Dev. Co. U.S.P. 2,401,896, 11.6.46. A process for separating alkyl and acetylenes from hydrocarbon mixtures.

F. E. Frey, H. J. Hepp, and G. H. Morey, assrs to Phillips Petroleum Co. U.S.P. 2,401,922, 11.6.46. Promotion of the thermal scission and polymerization of light hydrocarbons by addition of an alkylene oxide.

M. H. Gorin, assr to Socony Vacuum Oil Co. U.S.P. 2,401,925, 11.6.46. *Iso*-paraffins are alkylated with ethylene using aluminium bromide in solution in a paraffinic solvent.

A. B. Hersberger, assr to The Atlantic Refining Co. U.S.P. 2,401,933, 11.6.46. Lubricating oils are synthesized by polymerization of a propylene *iso*butylene mixture at − 10° to + 35° C in the presence of a Friedel–Crafts catalyst in a lower alkyl halide.

C. J. Pederson and R. O. Bender, assrs to du Pont de Nemours & Co. U.S.P. 2,401,957, 11.6.46. An inhibitor for gasoline and kerosine consisting of an alkyl derivative of 2-aminomethyl-4-aminophenol.

R. A. Salathiel, assr to S.O. Dev. Co. U.S.P. 2,401,966, 11.6.46. A process and agent for breaking petroleum emulsions.

W. D. Seyfried and S. H. Hastings, assrs to S.O. Dev. Co. U.S.P. 2,401,973, 11.6.46. Butylene is dehydrogenated to butadiene using magnesium oxide–iron oxide catalyst.

J. I. Wasson and G. W. Duncan, assrs to S.O. Dev. Co. U.S.P. 2,401,993, 11.6.46. A corrosion resistant composition consisting of a tertiary butyl ether of *o*-tertiary butyl *p*-cresol and a small proportion of " lorol " amine salicylate.

H. O. Folkins and C. M. Thacker, assrs to Pure Oil Co. U.S.P. 2,402,034, 11.6.46. A process for cracking hydrocarbons in the presence of a small amount of *p*-dibromobenzene.

V. N. Ipatieff and L. Schmerling, assrs to U.O.P. Co. U.S.P. 2,402,051, 11.6.46. A process of manufacturing catalysts from aluminium halide and phosphoric acid.

J. A. Patterson, assr to Standard Alcohol Co. U.S.P. 2,402,077, 11.6.46. Method of purifying *iso*propyl alcohol obtained by the treatment of propylene with sulphuric acid.

L. Schmerling and A. M. Duriński, assrs to U.O.P. Co. U.S.P. 2,402,092, 11.6.46. Aromatic hydrocarbons are alkylated with an alkyl halide in the presence of a silica catalyst.

L. F. Hatch, D. E. Adelson, and B. O. Blackburn, assrs to Shell Dev. Co. U.S.P. 2,402,113, 11.6.46. Monomeric butadiene is stabilized with 4-*tert.*-butyl catechol.

L. A. Clarke, assr to The Texas Co. U.S.P. 2,402,126, 18.6.46. Process for the continuous alkylation of *iso*butane with ethylene in the presence of an aluminium halide–hydrocarbon complex liquid catalyst.

G. Egloff, assr to U.O.P. Co. U.S.P. 2,402,243, 18.6.46. Styrene is obtained by reacting benzene with acetylene in the presence of a Friedel–Crafts catalyst on an inert granular porous support.

F. E. Frey, assr to Phillips Petroleum Co. U.S.P. 2,402,277, 18.6.46. A thermal process for the conversion of trimethylethylene to *iso*prene.

A. Lazar and J. C. Carter, assrs to Tide Water Associated Oil Co. U.S.P. 2,402,288, 18.6.46. A purified naphthenic base oil is sulphonated and the oil soluble sulphonic acids are converted to polyvalent metal sulphonates. The product is used as an oxidation inhibitor for lubricating oils.

A. C. Stoneman. U.S.P. 2,402,304, 18.6.46. A method of treating finely-divided activated carbon to remove the particles of lowest density, thereby increasing the adsorptive activity of the residual product.

W. K. Griesinger and E. H. Engelking, assrs to The Atlantic Refining Co. U.S.P. 2,402,325, 18.6.46. A method of producing an oil solution of a basic alkaline-earth metal sulphonate.

E. C. Herthel, assr to Sinclair Refining Co. U.S.P. 2,402,328, 18.6.46. Catalytic alkylation of *iso*butane.

J. E. Smith and P. J. Mitchell, Jr., assrs to Du Pont de Nemours. U.S.P. 2,402,351, 18.6.46. An aqueous emulsion of paraffin wax containing an aluminium salt and a modified protective colloid for use as a water repellent composition.

T. H. Whaley, Jr., assr to Phillips Petroleum Co. U.S.P. 2,402,355, 18.6.46. A design for a dispensing system for a volatile liquid.

R. B. Mason, assr to S.O. Dev. Co. U.S.P. 2,402,423, 18.6.46. Improvements in the continuous catalytic reduction of aromatic nitro-compounds to the corresponding amines.

H. H. Meier, assr to S.O. Dev. Co. U.S.P. 2,402,425, 18.6.46. Naphtha is subjected to thermal conversion and after elimination of oxygen and organic peroxides is extracted with sulphur dioxide.

J. J. Owen, assr to S.O. Dev. Co. U.S.P. 2,402,439–40, 18.6.46. Metal sulphides are used as catalysts with hydrogen to reduce aromatic nitro-compounds to amines.

A. H. Batchelder and F. S. Rollins, Jr., assrs to California Research Corpn. U.S.P. 2,402,487, 18.6.46. A foam inhibited oil is obtained by the addition of a small amount of a short chain nitro aliphatic alcohol to a lubricating oil.

B. S. Greensfelder and W. H. Peterson, assrs to Shell Dev. Co. U.S.P. 2,402,493, 18.6.46. A selective hydrogenation process to produce *mono*olefin compounds.

O. M. Reiff and J. J. Giammaria, assrs to Socony Vacuum Oil Co. U.S.P. 2,402,566, 18.6.46. A rubber-like wax substituted aromatic compound is obtained by the reaction between chlorinated wax and phenol, naphthols, and diphenyl ether in the presence of a Friedel–Crafts catalyst.

W. P. Hawthorne, assr to Socony Vacuum Oil Co. U.S.P. 2,403,922, 16.7.46. A hydrofluoric acid alkylation process.

C. S. Kuhn, Jr., assr to Socony Vacuum Oil Co. U.S.P. 2,403,929, 16.7.46. Hydrofluoric acid alkylation including a reforming stage.

C. S. Kuhn, Jr., assr to Socony Vacuum Oil Co. U.S.P. 2,403,930–1, 16.7.46. Hydrofluoric acid alkylation using ethylene, and sulphuric acid alkylation using ethylene, each catalyst being modified by addition of a specific salt.

W. N. Axe, assr to Phillips Petroleum Co. U.S.P. 2,403,963, 16.7.46. Formation of phenylbutenes from benzene and butadiene in the presence of a hydrated boron fluoride catalyst.

B. S. Friedman, assr to U.O.P. Co. U.S.P. 2,403,972, 16.7.46. Sulphuric acid containing a silver compound such as the sulphate, oxide, or carbonate is used to extract aromatics from its mixture with other saturated hydrocarbons.

J. C. Bailie, L. Heard, and R. V. Shankland, assrs to S.O.C. Indiana. U.S.P. 2,404,024, 16.7.46. A metal oxide catalyst for reforming naphtha.

G. R. Gilbert, assr to S.O. Dev. Co. U.S.P. 2,404,050, 16.7.46. Reforming of alkylate at 750–1100° F and 100–600 lb pressure to improve octane number.

E. Gorin, assr to Socony Vacuum Oil Co. U.S.P. 2,404,055, 16.7.46. Manufacture of aluminium halide catalysts.

E. Gorin and A. G. Oblad, assrs to Socony Vacuum Oil Co. U.S.P. 2,404,056, 16.7.46. Manufacture of *iso*prene from propylene.

J. P. Hamilton and C. F. Jones, assrs to S.O. Dev. Co. U.S.P. 2,404,061, 16.7.46. A system of pre-coat filtration for viscous liquids containing solids and tarry materials.

J. J. Heigl and J. A. Wilson, assrs to S.O. Dev. Co. U.S.P. 2,404,064, 16.7.46. An apparatus for investigating absorption spectra of substances.

C. E. Jahnig, assr to S.O. Dev. Co. U.S.P. 2,404,071, 16.7.46. A method of recovery of finely-divided particles from high temperature gases.

T. B. McCulloch, assr to S.O. Dev. Co. U.S.P. 2,404,080, 16.7.46. Normal paraffins are isomerized by the action of sulphuric acid at 300–500° F.

A. E. Robertson, assr to S.O. Dev. Co. U.S.P. 2,404,094, 16.7.46. A motor fuel consisting of 80–98% methyl alcohol and a minor proportion of a 3–5 carbon atom paraffin or naphthene sufficient to raise the Reid vapour pressure of the blend to 13 lb at 100° F.

L. Schmerling, assr to U.O.P. Co. U.S.P. 2,404,100, 16.7.46. A naphthene hydrocarbon is alkylated with an alkyl halide in the presence of an aluminium halide–nitroparaffin catalyst.

R. M. Shepardson, assr to S.O. Dev. Co. U.S.P. 2,404,104, 16.7.46. A solvent raffanate of a narrow cut naphtha fraction containing ethyl*cyclo*hexane is dehydrogenated in the presence of a catalyst and the ethylbenzene product is recovered.

W. N. Axe, assr to Phillips Petroleum Co. U.S.P. 2,404,120, 16.7.46. An alkyl aromatic is obtained by the reaction between an aromatic compound and a normal 1 : 3-diolefin in the presence of a catalyst followed by hydrogenation.

V. Scarth, assr to Phillips Petroleum Co. U.S.P. 2,404,253, 16.7.46. Extractive distillation of a C_4 cut with furfural.

G. B. Zimmerman, assr to U.O.P. Co. U.S.P. 2,404,340, 16.7.46. Propylene is polymerized and then the polymer is isomerized and then employed to alkylate a suitable hydrocarbon.

E. A. Evans and C. C. Wakefield & Co., Ltd. B.P. 583,551, 1.1.47. Lubricating oil compositions.

Du Pont de Nemours & Co. B.P. 583,804, 15.1.47. Polymerization or interpolymerization of mono-olefins. B.P. 583,850, 15.1.47. Polymerization or interpolymerization of ethylene.

W. B. Heaton and Trinidad Leaseholds, Ltd. B.P. 583,803, 15.1.47. Prevention of knock in I.C. engines.

I.C.I., Ltd. B.P. 583,805, 15.1.47. Polymerization or interpolymerization of *mono*-olefins.

S.O.C. California. B.P. 583,995, 15.1.47. Electromagnetic pick-up unit for determining the intensity of engine detonation.

J. C. Arnold, assr to S.O.Dev. Co. B.P. 584,121, 22.1.47. Method for the separation of propylene from ethylene.

I.C.I., Ltd., R. B. Richards, J. R. Myles, and D. Whittaker. B.P. 584,324, 22.1.47. Ethylene interpolymers also I.C.I., Ltd. (Du Pont de Nemours). B.P. 584,309, 22.1.47. Production of polymer products of ethylene.

Shell Dev. Co. B.P. 584,256, 22.1.47. Production of phenolic compounds.

G. R. N.

PRODUCTS.

Chemistry and Physics.

418. On the Course of the Reaction at 100° C in the System Paraffin/Oxygen. D. J. W. Kreulen. *J. Inst. Petrol.*, 1946, **32**, 656.—The oxidation of solid paraffin has been investigated. The quantities of peroxides and aldehydes formed are proportional to time, while the quantity of acids is a quadratical function of time. If copper is present the peroxides are destroyed and an increase in the quantity of aldehydes is observed. In conclusion, the results obtained with white oils, xylene, and solid paraffin are compared.

A. H. N.

419. Experiments on the Production of Toluene from Coal Tar Products and Other Sources. C. M. Cawley, J. H. G. Carlile, H. E. Newall, and F. E. T. Kingman. *J. Inst. Petrol.*, 1946, **32**, 660.—Great Britain's large toluene requirements during the war were met by increased production from coke-oven and gas-works benzole and by importation from the United States, where production from petroleum was carried out on a large scale. At the beginning of the war, however, it was uncertain whether sufficient toluene would be available, and a study was made of some of the ways of making this substance from coal-tar products—benzene, xylene, cresol, and naphthalene. Particular attention was given to the possibility of preparing toluene by the hydrogenation of cresol, and a continuous process working at a pressure of 10–20 atm and a temperature of 430–440° C was developed to a semi-technical scale (120 g.p.d.). A laboratory examination was also made of the cyclization of *n*-heptane. A. H. N.

420. The Vaporization of Fuels for Gas Turbines. Part I. The Bubble-Points and Dew-Points of Liquid Hydrocarbon Fuels. B. P. Mullins. *J. Inst. Petrol.*, 1946, **32**, 703.—The search for new and improved forms of gas-turbine combustion chambers naturally turns towards systems with perfect fuel atomization, an ideal that can be realized by pre-vaporization of the fuel. The evaluation of the vaporization characteristics of gas-turbine fuels described in this paper is the first step towards achieving this ideal. A review of the empirical methods devised during the past twenty-five years for determining the bubble-points and dew-points of liquid hydrocarbon fuels is given, and these are applied to standard fuels. Some practical determinations involving the preparation of "equilibrium solutions" by the method of Wilson and Barnard were also undertaken. Finally, a theoretical method for calculating bubble-points and dew-points, depending on a knowledge of the true boiling-point distillation curve of the fuel in question, was developed and applied to standard fuels. The calculations cover a static pressure range of 10^{-2} to 10 atm and have been extended to air–fuel ratios of 0 : 1 to 20 : 1. The main results for an aviation spirit, a kerosine, and a gas oil are presented in the form of nomograms. A. H. N.

421. Mechanism of the Catalytic Oxidation of Ethylene. (1) Experiments Using a Flow System. G. H. Twigg. *Proc. Roy. Soc.*, A, 1946, **188**, 92.—A description of experiments made using a flow system to determine the mechanism of the catalytic oxidation of ethylene on a silver catalyst. The effect of time of contact, gas concentration, and temperature were investigated. The products of reaction were ethylene oxide, carbon dioxide, and water. Carbon dioxide appeared to be formed: (*a*) by direct oxidation of the ethylene, not via ethylene oxide, and (*b*) by the further oxidation of the ethylene oxide.

Isomerization of ethylene oxide to acetaldehyde by the catalyst in absence of oxygen was also examined, and by comparison with the oxidation of ethylene oxide it was shown that this latter reaction proceeds to a large extent, and possibly entirely, through a preliminary isomerization of the ethylene oxide to acetaldehyde. The rate of oxidation of the latter was extremely rapid and no trace of it was found during the oxidation of ethylene or ethylene oxide. Ethylene oxide forms an involatile deposit on the catalyst, oxidized by oxygen, so that during oxidation reactions the quantity of it on the catalyst was kept low.

The kinetics of the oxidation of ethylene, *i.e.*, rate of reaction proportional to the oxygen concentration and slightly dependent on the ethylene pressure, are consistent with the view that ethylene reacts with oxygen adsorbed on the catalyst and that the slowest step in the whole series of reactions is the rate of adsorption of the oxygen. An energy of activation of about 27 kcal was found for the production of ethylene oxide, and slightly less for the production of carbon dioxide and consumption of oxygen. T. M. B. M.

422. Mechanism of the Catalytic Oxidation of Ethylene. (2) Reactions Between Ethylene, etc., and Chemisorbed Oxygen Monolayers. G. H. Twigg. *Proc. Roy. Soc.*, A, 1946, **188**, 105.—Experiments have been carried out at temperatures of 263° C and higher between oxygen adsorbed as atoms on the silver catalyst, and ethylene, ethylene oxide, and acetaldehyde.

The course of reaction was followed by measuring the change in pressure, and

analyses of the products were made by micro-fractionation of the gases at low temperatures.

In the reaction of ethylene with an oxygen-covered catalyst, the absence of an induction period in the pressure–time curve showed that oxidation of ethylene to carbon dioxide and water by a route not through ethylene oxide is possible. The reaction of acetaldehyde with the oxygenated catalyst was too fast to measure. The reactions of ethylene oxide were found to be complex and occurred both with the oxygenated and the clean catalyst. On a clean catalyst, ethylene oxide was simultaneously isomerized to acetaldehyde and converted back to ethylene and adsorbed oxygen; the acetaldehyde and adsorbed oxygen then reacted to form carbon dioxide and water.

Both ethylene oxide and acetaldehyde, but not ethylene, were adsorbed with decomposition to form a non-volatile layer on the catalyst. This was composed of carbon, hydrogen, and possibly oxygen, combined in indefinite and varying proportions.

The kinetics of the reaction between ethylene and the adsorbed oxygen layer were measured. Throughout the course of any one reaction, the rate of oxidation to carbon dioxide was proportional to the square of the concentration of adsorbed oxygen, but the velocity constant depended on the initial concentration. The apparent energy of activation was 10 kcal.

It is thought that when ethylene reacts with a single adsorbed oxygen atom, ethylene oxide is produced, and that with a pair of adsorbed oxygen atoms, intermediates such as formaldehyde are produced which react rapidly to form carbon dioxide and water.

T. M. B. M.

423. Mechanism of the Catalytic Oxidation of Ethylene. (3) The Reactions Between Ethylene and Oxygen in a Static System. G. H. Twigg. *Proc. Roy. Soc.*, A, 1946, **188**, 123.—Static experiments have been carried out between ethylene and oxygen on the silver catalyst at different pressures and temperatures, and the rates of the several reactions occurring were determined. It was found at 263° C that: (i) the rate of oxidation of ethylene to ethylene oxide is proportional to the ethylene pressure (a) and to the first power of the concentration (b) of adsorbed oxygen on the catalyst. (ii) The rate of the direct oxidation of ethylene to carbon dioxide is proportional to (a) and to the square of (b). (iii) The rate of oxidation of ethylene oxide is proportional to (a) and independent of (b).

The kinetic equations for the course of reaction with time, although incapable of analytical solution, were integrated by means of the Bush differential analyser, the numerical constants being fitted to one series of experiments. The goodness of fit and the accuracy of the predictions were confirmation of the kinetics deduced.

These results confirm previous findings that the main steps in the reactions are: (i) chemisorption of oxygen as atoms on the catalyst surface, (ii) reaction of gaseous or weakly adsorbed ethylene either with one oxygen to form ethylene oxide, or with two atoms to form products which are oxidized rapidly to carbon dioxide, and (iii) isomerization of ethylene oxide to acetaldehyde followed by the rapid oxidation of this to carbon dioxide. Energies of activation were measured for these steps.

An attempt was made to measure directly the concentration of oxygen adsorbed on the catalyst during reaction, by cleaning it with hydrogen after pumping out the reaction mixture; a value of 0·31 was found which was in fair agreement with that expected from the machine solutions.

T. M. B. M.

424. Equilibrium Constants of Some Reactions Involved in the Production of 1 : 3-Butadiene. F. G. Brickwedde, M. Moskow, and J. G. Aston. *Bur. Stand. J. Res. Wash.*, November 1946, **37** (5), 263.—Thermodynamic functions including free energy, enthalpy, entropy, and specific heat for butadiene, benzene, *cyclo*hexane, ethane, ethylene, ethyl alcohol, and water and for the elements carbon (graphite), hydrogen, and oxygen are given. From these are calculated and tabulated values of equilibrium constants for reactions of interest in connection with the production of 1 : 3-butadiene for synthetic rubber. Table values and available experimental data on equilibrium constants, gaseous specific heats, and entropies are compared. Hydrocarbon cracking is discussed and the importance of reaction rates in determining the amounts of reaction products is noted.

T. M. B. M.

425. Burnett Apparatus Used for Gas-Deviation Determinations. E. N. Armstrong. *Oil Gas J.*, 7.12.46, **45** (31), 82.—An apparatus for the determination of the deviation of natural gas from Boyle's law, and method of operation is described.

The apparatus includes a very accurate piston gauge with weights ranging from 1/100 lb to 500 lb to total 4000 lb, a steel diaphragm cell for accurate balancing of pressures, and a steel bomb with two chambers for obtaining pressure ratios, and auxiliary equipment.

Any gravity of gas can be tested at any pressure and temperature from 0 to 4000 lb and minus 20° to 400° F respectively.

The apparatus measures a series of pressures in order to establish pressure ratios at a constant temperature.

Representative gas samples, free from condensed liquids, must be drawn, temperatures should be arranged accordingly.

Results on a test run at 70° F on natural gas of 0·593 specific gravity are tabulated.

G. A. C.

426. Photochemical Polymerization of Butadiene. D. H. Volman. *J. Chem. Phys.*, 1946, **14**, 467.—Investigations were made on mercury photosensitized polymerization of butadiene and mixtures of butadiene and acetone in the gas phase, and the photochemical reactions in solutions of butadiene and acetone in hexane. Metal mirror experiments have shown the absence of hydrogen atoms and the presence of alkyl radicals at low pressures. The mechanism proposed for butadiene vapour postulates an activated butadiene molecule produced by collision with activated mercury and competition between deactivation by collision, predissociation into free radicals and a collisional process to give hydrogen gas. The polymerization chain proceeds by a mechanism involving either free radicals or hydrogen atoms. In the presence of acetone vapour, the rate is increased and the increase is directly proportional to the number of free radicals coming from acetone, indicating that polymerization chains are not broken by bimolecular gas phase reaction between free radicals. For butadiene alone at 53-mm pressure and 43° C the quantum yield was 0·24. The average number of molecules reacting per free radical formed was calculated to be between 3 and 8. The liquid solution results are explained on the basis of a modified Frank–Rabinowitch hypothesis for the primary photochemical process. By collision with hexane, the activated acetone molecules become deactivated and react with acetone to yield unsaturated compounds and with butadiene to initiate polymerization. The following kinetic equation is developed for the rate of polymerization,

$$dP/dt = (kI_{abs.}/I_0)(n[C_4H_6] - [(CH_3)_2CO]),$$

where n is the average number of molecules reacting per free radical. n is taken equal to 4.

J. T.

427. Physical Constants of Low-Boiling Hydrocarbons and Miscellaneous Compounds. W. S. Hanna and R. Matteson. *Oil Gas J.*, 11.1.47, **45** (36), 61.—Physical constants, selected as far as possible from A.P.I. Project 44 have been compiled; representing the fourth revision of the table originally commenced in 1937.

Molecular weights and carbon hydrogen ratios are as previously reported; but changes have been made in the melting-point and boiling-point values. Minor revisions have been made in the critical temperature data. Density, gas-law deviation factors, and specific heat values have been revised, as also have the figures for air for combustion, inflammability limits, aniline point, and octane number.

A bibliography of 91 references is also given.

G. A. C.

428. Plastic Flow, Creep, and Stress Relaxation. Part I. Plastic Flow. C. Mack. *J. appl. Phys.*, 1946, **17**, 1086.—Plastic substances are considered to be composed of units of flow with various yield values. It is shown that in this case the product of the strain rate and viscosity is equal to the sum of the differences between the applied stress and the yield values. This relationship can be applied to any plastic system free of elastic after-effect and expresses their mechanical properties in terms of a coefficient of viscosity which is independent of the stress applied. With the proper choice of the distribution of yield values any kind of relation between stress and strain rate can be established. The relationship is applied to plastic flow which is defined as a deforma-

tion mechanism having a curvilinear relationship between stress and rate of deformation and a constant rate of deformation at constant stress. Equations are given for the coefficient of viscosity of such systems and for the relaxation of stress at constant deformation as a function of time. A. H. N.

429. Plastic Flow, Creep, and Stress Relaxation. Part II. Creep. C. Mack. *J. appl. Phys.*, 1946, **17**, 1093.—The general equation covering the deformation of plastic substances given in Part I is applied to creep. Creep is defined as a mechanism of deformation for systems which have a curvilinear relationship between stress and strain rate and a curvilinear relationship between strain and time at constant stress. Creep is connected with changes in the internal structure of a plastic substance and results in an increase in strength of such materials through work-hardening. Equations are derived which give the stress as a function of strain rate and time (time-hardening), as a function of strain rate and strain (strain-hardening) and as a function of strain rate, strain, and time. The difference between time-hardening and strain-hardening is discussed. Expressions are given for the coefficients of viscosity of such systems which are independent of the stress applied. The relaxation of stress at constant strain is discussed, and it is shown that the stress relaxation depends upon the history of the substance under test. The concept of creep is also applied to thixotropic systems which are considered as cases of work-softening. A. H. N.

430. Plastic Flow, Creep, and Stress Relaxation. Part III. Creep and Elastic After-Effect. C. Mack. *J. appl. Phys.*, 1946, **17**, 1101.—A large number of substances show the phenomenon of elastic after-effect, and part of their deformation recovers on unloading as a function of time. This portion of the deformation at constant stress has a strain rate which decreases with time and is therefore comparable to creep. Expressions are given for the strain–time relationships of such systems, and the process of stress relaxation at constant strain is discussed. The equations given in connection with plastic flow, creep due to work-hardening, thixotropy, and creep in combination with elastic after-effect are applied to data given in the literature, and it is shown that these equations suffice to describe the deformation and relaxation mechanisms of a variety of materials such as metals, clay soil, food products, acrylic acid polymeride, polyvinyl chloride, cellulose acetate, manila ropes, paper laminates, phenolic moulding compounds, rubber, asphalt, and bituminous pavements. A. H. N.

431. Tendency to Smoke of Organic Substances on Burning. Part II. Smoke Production and Burning Characteristics of Hydrocarbon Gels. F. H. Garner, T. G. Hunter, and A. E. Clarke. *J. Inst. Petrol.*, 1946, **32**, 643.—In a previous paper a description has been given of the tendency of organic substances to smoke on burning and in the present paper the smoke production during the burning of hydrocarbon gels has been investigated. The weight of smoke formed has been determined and the obscuring power of the smoke cloud measured by an optical density method. The burning characteristics of the gels were also examined. These burning characteristics have been assessed by determining the unburned residue resulting from the combustion of a constant weight of gel with a constant burning area exposed, together with the time of burning and maximum and mean flame heights. The effect of the following variables on the above measurement has been investigated and discussed in detail: (1) Chemical composition of the hydrocarbon base; (ii) Volatility of the hydrocarbon base; (iii) Viscosity of the gel.

For reduction of smoke formation, the composition of the hydrocarbon base was found to be most important, while the volatility was equally important in controlling the burning characteristics. The viscosity of the gel had no apparent effect on smoke production. A. H. N.

432. Thermodynamic Properties of Hydrocarbons. I. Theoretical Aspects of the Calculation of Thermodynamic Data from Spectroscopic Data. T. Reis. *Rev. Inst. Franç. Pétrole*, 1946, **1**, 33.—This paper reviews the published formulæ dealing with statistical mechanics, infra-red and Raman spectra and symmetry in polyatomic molecules. The function of distribution, as regards polyatomic molecules, is dealt with in greater detail. The case of molecules with and without internal rotation is considered and the part played by rotational and vibrational factors in the distribution

function is tabulated. Potential barriers for the case of hindered internal rotation are explained and numerical values, selected from the literature, are given for different compounds at varying temperatures. The calculation of latent and specific heats, entropies, free energies, and equilibrium constants for compounds of various types is demonstrated. As a detailed example the equilibrium constants for the system ethane-ethylene are calculated for temperatures of 653, 723, and 863° K.

II. Numerical Data and Examples. N. Tcherkezoff. *Ibid.*, 1946, **1**, 50.—In this section a selection has been made of the values published in the literature for constants such as the heat of formation, free energy, entropy, and heat of vaporization of various hydrocarbons. The figures are tabulated, as are the general thermodynamic formulæ applicable to various hydrocarbon types. Detailed consideration is given to the calculation of the free energies of some of the more important paraffins, the discussion in each case being based on previously published figures. V. B.

433. Thermodynamic Properties of Hydrocarbons. II. Numerical Data and Examples. N. Tcherkezoff. *Rev. Inst. Franç. Pétrole*, 1946, **1**, 107.—This is a continuation of a previous paper (see Abstract No. 432/47). The thermodynamic properties of olefinic, acetylenic, and cyclic hydrocarbons are discussed on the basis of published data. Some examples are given of the application of free energy calculations to polymerization, isomerization, cracking, and alkylation reactions. The paper includes 11 tables giving properties such as critical constants, heats of combustion and formation, equilibrium constants for some of the principal reactions and other thermodynamic data for numerous hydrocarbons of all types. V. B.

434. Water and *n*-Hexane. D. L. Katz, G. H. Hanson, H. S. Kemp, and E. G. Opdyke. *Refiner*, 1946, **25**, 419.—Experimental atmospheric boiling and condensing film coefficients obtained on a laboratory unit are presented for water and *n*-hexane. Inside film coefficients for condensing steam are given. The temperature variations around and along the boiling and condensing tubes are illustrated. G. R. N.

Analysis and Testing.

435. The Four-Ball Oil Tester. C. F. Krienke (trans. by E. J. Barth). *Refiner*, 1946, **25**, 467.—Several tests on three different oils were made on a four-ball test machine—straight run mineral oil, a 100% fatty oil, and a mineral oil containing elementary sulphur in solution. The results were somewhat scattered. When enough tests are made, however, wear values and seizure constants are obtained which show definite trends and are concordant. Wear tests show that sulphur exerts an extremely favourable anti-wear action on metallic surfaces, far surpassing a mineral oil and even fatty oils, which have been though of as being good oils. G. R. N.

436. 50°–100° A.P.I. *Versus* Specific Gravity. W. L. Nelson. *Oil Gas J.*, 11.1.47, **45** (36), 89.—No. 126 in the Refiner's Notebook series gives a chart showing conversion of degrees A.P.I. to specific gravity. The range is from 50° to 100° A.P.I. (0·7796 to 0·6115 specific gravity) in tenths of degrees. G. A. C.

437. New Methods for Determining the Anti-Knock Values of Aircraft Fuels. M. L. Thaler. *Bull. Assoc. Franç. Tech. Pét.*, 1946, (60), 39.—A review of methods available for measuring O.N.'s above 100. War-time developments in the U.S. and U.K. are described with particular reference to the "F.4" and "Performance Number" methods of fuel evaluation. Some German results on the injection of water and of alcohols (methyl and ethyl) on the maximum power output of supercharged engines are given. These show that the most effective instant for the injection of water is 120–140° before top dead centre on the compression stroke. On aircraft engines, using direct fuel injection with alcohol introduced into the induction manifold, it was possible by the use of mixtures of methyl alcohol (aqueous) and 87 O.N. fuel to obtain a performance equivalent to that yielded by 100 O.N. fuel, without increase of fuel consumption. The results of these German tests on gasoline/alcohol/water blends are presented graphically. The occurrence of detonation in these tests was detected by a rise in the temperature of the engine coolant. French research on fuel problems has

been hampered, since the end of the war, by the lack of test equipment, the few engines available being engaged in routine testing. It is urged that the French industry should adopt U.S. test methods and correlate these with the performance of French aero-engines; only if this were to show wide variations between laboratory results and those in practice should French test methods be developed. V. B.

438. Specimen Study of a Hydrocarbon Mixture by the Raman Effect. —. Delwaulle, F. Francois, and J. Wiemann. *Chim. et Ind.*, 1946, **56**, 292.—A synthetic gasoline was fractionated into 10 cuts boiling in the range 40–159° C. Each cut was subjected to spectroscopic (Raman) analysis. The principal saturated and unsaturated hydrocarbons present in each fraction were identified by their characteristic bands. The saturated hydrocarbons are all straight chain compounds; if any branch chain compounds are present their amount is small. Among the unsaturated hydrocarbons the lower members are straight chain but branching increases with a rise in mol. wt. Chemical analysis shows that the olefin content decreases with a rise in b.p. V. B.

439. Molecular Weights in Practice and Theory. 1. Practice. 2 (2). Physical Methods. A. V. Brancker. *Petroleum*, 1946, **9** (12), 274.—The methods discussed include ebullioscopic methods (Beckman and Menzies–Wright) and the Rast camphor method for substances of low and medium mol. wt. For polymeric substances the methods described are the viscosity method, the osmotic method and finally the ultra-centrifuge method as developed by Svedberg. Full references to the appropriate literature are given. K. C. G. K.

440. Crankcase Oil Ageing Tests (2). M. Freund. *Petroleum*, 1946, **9** (11), 255.—Details are given of a laboratory method of test suitable for the determination of foreign solids, hard asphalts, and petroleum resins in used crankcase oil using one and the same sample. Oil-dilution must always be taken into consideration in the case of combustion engines. In such cases, the oil-samples must be freed from heavy fuel-ends as far as possible. For reproducible results, oils drawn from the crankcase should be stored for an equal period of time prior to examination. They should be vigorously shaken at 150° C and all samples should be weighed at the same time, both because of the settling of suspended sludge and the effect of auto-oxidation and polymerization. Samples should be moisture free. K. C. G. K.

441. Crankcase Oil Ageing Tests (3). M. Freund. *Petroleum*, 1946, **9** (12), 278.—The determination of the neutralization numbers of used crankcase oils and the effect of sludge is discussed. To demonstrate the latter effect three methods of titration are used: (1) Titration of the original used oil in a glass beaker; (2) Titration after centrifuging the used oil dissolved in alkali blue mixture (titrating in the centrifuge tube); (3) Titration of the used oil in a glass beaker; the oil is previously desludged by centrifuging.

Data are given to show that acid compounds of oil sludge pass over into the alkali-blue mixture solution when titrating used oils. Further data derived from service tests in the engines of a diesel-electric paddle-wheel river tug are given to show that the properties of used oils are determined by service conditions of the engine at least as much as by minor differences in the qualities of the oils themselves. K. C. G. K.

442. Static Determination of the Yield Value of Plastic Systems by the Withdrawal Method. Its Application to Drilling Muds. R. Metrot. *Rev. Inst. Franç. Pétrole*, 1946, **1**, 79.—The withdrawal method for the study of drilling muds, consists in suspending a thin metal plate vertically in the sample, by means of a wire attached to one beam of a balance; the balance is counterpoised with sand till the plate is withdrawn from the sample. The plate, which may be of any shape or size, provided that the ratio of thickness to area is small and that sharp corners or perforations are absent, is previously calibrated by immersion in a "true liquid," *i.e.*, one having no plasticity. The yield value τ is given by the expression $\frac{mg}{2S}$ where m is the mass of sand required to counterpoise the balance and S is the area of the plate; it is expressed in dynes/cm.^{2}

The application of this test to clay suspensions divides these latter into two groups,

(*a*) non-thixotropic muds whose yield value is independent of standing time, and (*b*) thixotropic gels whose yield value varies with the standing time that has elapsed after agitation of the sample. Despite all the precautions that can be taken the results given by this test are scattered and should be subjected to statistical analysis. The time t elapsing between the application of the load m and the withdrawal of the plate, varies exponentially with m; this measurement is only significant in the case of non-thixotropic muds, when t can vary from zero to infinity. An examination of the yield value as a function of the concentration shows that plasticity only appears beyond a certain minimum concentration λ denoted as the liquidity limit; below which solutions behave as true liquids and above which yield values make themselves evident and increase, till a critical concentration, P, is reached above which mixtures behave not as a suspension but as a porous medium which is saturated with water. On plotting the yield value against concentration on logarithmic co-ordinates there is obtained an S-shaped curve, which in addition to vertical asymptotes at values of the concentration corresponding to λ and P also shows a break at a value of $C = \frac{\lambda + P}{2}$, for which the corresponding yield value is denoted by a. The values of a, λ, and P are characteristic for the clay under examination, experimental figures are given for nine French clays which were investigated. The value of $P - \lambda$ is the plasticity index; it is of the order of 25 for non-thixotropic clay muds but falls to about 10 for thixotropic gels made from bentonites. The thixotropy of solutions of this latter is discussed and results showing the change of yield value on the ageing of solutions are given. It is concluded that the withdrawal method has the merit of simplicity and, whilst not adequate for determining all the rheological properties of clay suspensions and plastic systems, it can nevertheless give much information which is of immediate practical value. V. B.

443. Physical–Chemical Methods for the Analysis of Hydrocarbons and Hydrocarbon Mixtures. I. Infra-Red Spectrography and Its Applications. L. Robert. *Rev. Inst. Franç. Pétrole*, 1946, **1**, 102.—A review. After an introductory definition of infra-red radiation and absorption, the principle of the infra-red spectrometer is explained and the characteristic features of the spectra of pure substances and of mixtures are briefly touched upon. The limit of accuracy of the method, when applied to petroleum problems, is discussed. V. B.

444. On the Application of Relative Light Dispersion to the Analysis of Hydrocarbon Mixtures. B. V. Joffe. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **53**, 433 (in English).—The relative dispersion ω is defined by the relation $\omega = n_1 - n_3/n_3$, where n_1, n_2, n_3 are the refractive indices at three wave-lengths λ_1, λ_2, λ_3 such that $\lambda_1 < \lambda_2 \leq \lambda_3$, these being in the present case the H_F, Na_D, and H_C spectrum lines. Computations from literature data show that for paraffins and naphthenes ω has a mean value of 17·5 and is nearly double this value for monocyclic aromatics. For a mixture of saturates and an aromatic the relative dispersion is given by a simple additive function of the relative dispersions and weight fractions of the components. In the analytical application of this relation, the Abbe refractometer is used to measure both n_D and $n_F - n_C$, the latter quantity being obtained directly from the reading of the refractometer compensator and corrected graphically for variations in n_D, upon which it is dependent. For a single aromatic a set of linear graphs relating aromatic content and compensator reading can be constructed. Mixtures containing olefins also can be analysed by including an additional term involving the iodine value. Tests on about 100 synthetic mixtures each containing two or three hydrocarbons of the three types considered indicate that the aromatic content can be determined with an absolute accuracy of 1–2%. This can be improved by using the more precise Pulfrich refractometer. The method is claimed to be simpler, more rapid and more precise than that of Grosse and Wackher. G. H. B.

445. The Non-Adiabatic Functioning of Fractionating Columns. M. Simonetta and C. Capitani. *Chim. e Industria*, **28**, 7–8, 115.—A method of assessment of laboratory columns is proposed which, taking account of the heat dispersed from the column, allows of a more precise calculation than usual of the number of theoretical plates. The results obtained in the assessment of a column 150-cm high are reported and agree fully with the theoretical calculation. D. H. McL.

Gas.

446. Super-Expansibility of Methane–Ethane Mixtures. W. O. Clinedinst. *Refiner*, 1946, 25, 296.—Methane–ethane mixtures expand more readily than is indicated by the ideal gas laws and this phenomenon is called super-expansibility. This deviation from the ideal has been approximated as the compressibility factor Z or its reciprocal expansibility Y which affects the flow of gas through pipe. This factor has been incorporated in a general flow equation based on the Weymouth formula. Two graphs of super-expansibility flow correction factors for methane–ethane mixtures are given.
G. R. N.

447. Liquefied Petroleum Gas. G. G. Oberfell and R. W. Thomas. *Refiner*, 1946, 25, 158.—LPG comes from 3 sources, natural gasoline plants, refineries and cycling plants, the latter being a relatively recent source in which is utilized the physical phenomenon of retrograde condensation. Some of the most important markets in which LPG is used in large quantities are: motor gasoline blending, refining processes, synthetic rubber components, chemicals, carbon-black and plant fuel. The demand for these lighter hydrocarbons has even increased since the end of the war and it is expected that this demand will continue for several years to come. Less butane will be required for adjustment of gasoline vapour pressures, since increased cracking facilities have resulted in production of gasoline with original higher vapour pressures than formerly. However, since propane was substituted for butane in the blending of motor fuel, about 1·5 times the amount of LPG used in 1945 will be needed for this purpose. When blended with motor gasoline, butane is worth slightly more than motor fuel prices which are considerably above current LPG prices. If high octane number should become a competitive factor in the marketing of motor gasoline, it is possible that a number of alkylation plants using large quantities of *iso*butane and the C_3–C_5 olefins will be operated. Possibly between 2 and 4 million gal a day of butanes will be required for the post-war programme of synthesis of motor fuel and aviation components. The quantity of light hydrocarbons, especially propane, used for the production of chemicals is increasing steadily but still represents only 20–50% of the light hydrocarbons consumed by the LPG industry. The introduction of butane and propane in residue gas going to existing plants increased carbon-black production. Butane and propane cannot be extracted from residue gas beyond a certain point if a specified minimum carbon-black yield per cu. ft of residue gas burned has to be maintained.
G. R. N.

Engine Fuels.

448. Relation of Octane Number and Peroxide Content of Gasolines. H. Velde (trans. by E. J. Barth). *Refiner*, 1946, 25, 285.—A record of storage data on straight run, vapour-phased cracked and mixed straight run–cracked gasolines with or without inhibitor, tetraethyl lead or alcohol addition. It shows that octane number falls as the peroxide number rises with the undoped gasolines and with most of the doped gasolines. Removal of the peroxides by acidic ferrous sulphate solution raises the octane number to somewhat short of the original value. Storage was carried out over 2 years in galvanized and iron drums.
G. R. N.

449. Evaluation of Sulphur Compounds in Gasolines. F. C. Moriarty. *Refiner*, 1946, 25, 490.—Three groups of sulphur compounds may occur in gasolines: (1) acidic compounds such as H_2S and mercaptans, (2) neutral but thermally unstable substances as mono- and disulphides, (3) thermally stable compounds such as thiophenes. Group (1) can be determined directly and group (2) can be determined after catalytic desulphurization as H_2S; any remaining sulphur can be classified as group (3). Lead susceptibility is affected by the first two groups so their removal is always desirable. Group (1) sulphur compounds can be removed by aqueous caustic, Girbotol or Shell T.P.P. processes and the Unisol process. Sweetening with doctor or copper reagents oxidizes the mercaptans to disulphides and these are only recommended for very low mercaptan contents. With straight-run gasoline of relatively high mercaptan content catalytic desulphurization is preferable to extraction whereas the reverse holds for cracked gasoline. The Isoform catalytic process for treating cracked gasolines is

competitive with the Unisol process. It effects little desulphurization, its principal advantage being isomerization. G. R. N.

450. Lead Tetraethyl as an Anti-Detonant. B. Ventura. *Chim. e Industria*, **28** (9–10), 149.—Having given a brief sketch of the first preparation of this important product (1854), the author describes two of the numerous industrial methods suggested and patented. He gives an exhaustive discussion of the manufacture of the product, describing the composition of the lead–sodium complex most convenient in practice, together with methods of analytical process control. The compositions of the various anti-knock blends are discussed and a table is given relating variation of density with temperature for one of the commoner blends for aviation engines. A description is given of the two most commonly used methods for the analysis of the commercial product or its blends with ethylene dibromide. Comments are made on the practical use of a quick electrolytic method which tends to give higher results than those obtained by ordinary methods. D. H. McL.

451. Comparison between Tetraethyl Lead and Nitrogenous Organic Anti-Detonants, and the Increase in Octane Number Attained by the Use of Both. Part II. G. Roberti, C. Minervini, E. Pipparelli, and E. Semmola. *Riv. ital. Petrol*, Oct. 1946, **162**, 15.—A general article dealing with the stability of alkylate, with and without methyl aniline, the anti-knock characteristics of gasoline blends containing amines and tetraethyl lead, and aero and automobile engine testing of these types of fuels. D. H. McL.

452. Review of the Chemical Structure of Fuels and Their Detonation in Engine. A. G. Mazurkiewicz and V. G. Oberholzer. *J. Inst. Petrol.*, 1946, **32**, 685.—Due to the large accumulation of data published by the many laboratories working on the subject of combustion during the war, a need has arisen for a general review of the results. An attempt has been made here to bring out the salient features of the methods of investigation employed in this field. Some general suggestions have been put forward for the different classes of compounds considered in an effort to correlate chemical structure with engine performance of fuel and fuel additives. A. H. N.

Gas and Fuel Oils.

453. Cetane Number of Diesel Fuel. W. C. Friske. *Refiner*, 1946, **25**, 517.—A nomograph is set out relating the cetane number of a diesel fuel (straight run or cracked distillate) to A.P.I. gravity and boiling-point index (SKZ scale of Vorberg). G. R. N.

454. Applying Combustion Knowledge. The Very Best in Oil Heating Depends on 101 Engineering Details. J. W. Schulz. *Fueloil & Oil Heat*, October 1946, **5**, 58.—This paper completes the series on combustion testing complications (see Abstracts Nos. 135 and 136, 1947) and reviews and expands the data already given on the determining and reporting of efficiencies of boilers and furnaces as computed from charts and tables from stack and CO_2 readings. Care is needed in reporting the results under such terms as Over-all efficiency and Absorption efficiency as all charts and tables are not constructed on the same basis, moreover on–off periods of firing greatly affect the efficiency. The terms Over-all efficiency and Absorption efficiency are explained and illustrated by diagrams, and practical means are discussed by which such installations may be improved to effect greater efficiencies. W. H. C.

455. Horizontal Rotary Burner Service. Some Hints on the Maintenance of a Clean Heavy Oil Fire. K. Steiner. *Fueloil & Oil Heat*, Oct. 1946, **5**, 52.—A sketch is given of the air nozzles and corresponding atomizers of fixed and adjustable horizontal rotary oil-burners which shows the nozzle bore, atomizer diameter and the clearance between the edges of both. A diagram shows a typical hook-up of the burner, its integral oil pump, piping and auxiliaries of the system. Regular observation of the burner flame and condition of the furnace will afford evidence of some of the imperfections in burning. These and other indications useful in detecting the cause or causes of defective burning or defects in the installation are discussed, and the methods for their

correction to obtain better burner performance are given. Two diagrams useful in this connection are shown. W. H. C.

456. Significance of Cetane Number in Fuels. E. F. Griep and C. S. Goddin. *J. Soc. aut. Engrs*, 1946, **54**, 436.—Although Cetane No. is important as a measure of ignition quality, it is suggested that it is not the only criterion of a good diesel fuel. Properties concerned with the rate of flame propagation during the combustion stage are also important. However, high cetane fuels show no great advantage in engines of present-day design but it is indicated that engines specially designed could give high power output on these fuels. It is suggested that combustion research is needed to determine the optimum composition of fuels for high power output. Ignition promoters are discussed and results given for amyl nitrite blends with 50 Cetane No. fuel. G. P. K.

Lubricants.

457. Physical Properties and Chemical Constitution of Lubricating Oils. M. Freund (trans. by E. J. Barth). *Refiner*, 1946, **25**, 521.—Several lubricating oils of U.S., Rumanian, and Russian origin were analysed, and it was concluded that when well-refined lubricants are grouped together as to their similar viscosity at 50° C, then the specific gravity is a characteristic of the average chemical composition and for all such other physicochemical properties that are dependent on constitution. With an increase in the specific gravity, the average boiling-point, the mol. wt., the aniline point as well as the hydrogen content appears to decrease in regular fashion. In accordance with this it is found that the viscosity–temperature curve becomes more steep and the Conradson carbon value appears to decrease. With a further increase in aromatics and naphthenes the lower resistance towards sludge formation (evident throughout with increase in aromatics) finally becomes very pronounced. Certain of these properties can be affected by degree and type of refining, the presence of colouring matter or asphalts, etc. G. R. N.

458. Physical Chemistry of Lubricating Oils. A. Bondi. *Refiner*, 1946, **25**, 337.—This, the second article of the series, discusses the dependence of viscosity on temperature, pressure, and concentration. The relationship between the temperature, pressure, and blending coefficients of viscosity and the chemical composition of lubricants is interpreted in terms of the Eyring theory of flow. A section is devoted to the anomalous flow of lubricating oils: at low temperatures or due to temperature gradients within the fast-flowing oil films, or due to the presence of high mol.-wt. additives which have now gained a place of prominence in many important applications. The final section deals with the application of present knowledge about lubricating oil behaviour under the influence of high-velocity gradients and high specific pressure to the calculation and lubrication of journal bearings. G. R. N.

459. Physical Chemistry of Lubricating Oils. A. Bondi. *Refiner*, 1946, **25**, 387.—In this, the third and final of the series, the optical and electrical properties of lubricating oils are discussed under: measurement of colour, nature of colour substances, ultra-violet absorption, infra-red absorption, and Raman spectra, fluorescence, refractive index, and optical rotation, dielectric constant and dipole moment, dielectric loss, electrical conductivity and related phenomena, dielectric strength, electrochemistry and voltolization. 142 references for the complete series. G. R. N.

460. Recent Developments in Lubrication. S. J. M. Auld. *Petrol. Times*, 28.9.46, **50**, 998.—The advantages of mineral oils over other substances for use as lubricants are discussed. Mineral lubricating oils do have certain disadvantages, however, chief of these being viscosity variation with temperature, and oxidation at high temperatures and pressures. Methods of improving lubricating oil properties fall into three classes: (1) improvements in refining technique, (2) use of additives, (3) synthesis, and also (4) combinations of these. Recent developments along these lines are briefly reviewed. R. B. S.

461. Detergent and Dispersive Properties of Engine Oils. J. Groff. *Rev. Inst. Franç. Pétrole*, 1946, **1**, 3–15.—A review of the causes of oil deterioration and of the effect

of this on engine operation. Dispersive power is considered to be more important than detergency. The introduction of HD oils into France gave rise to trouble due to the use of such oils in old and dirty engines. Results are given of stability tests (heating for 22 hr at various temperatures) on SAE 30 and 50 oils, both of the HD type and on such oils after treatment with adsorbents to remove the additive. Taking as an indication of deterioration the rise in viscosity and in petroleum ether insolubles there was in each case a marked change at 275° C, indicating that the oils should be used at temperatures below this figure; the removal of the additive had no appreciable effect on the formation of insoluble matter but, in the case of the SAE 50 oil it caused a drop of 11% in viscosity. Engine tests (Citroen 11 hp operating on producer gas) using an initial charge of lubricant derived from shale oil and topped up during the test (50 hr) with HD 30 showed that the latter had two distinct effects, during the first period there was a detergent action, in the second period (after the 40th hr), when the proportion of HD oil in the crankcase was appreciable, the dispersing power was the more marked. These conclusions are supported by photomicrographs of the oil. A brief account is given of the engine and foaming tests used in testing oils to the U.S. 2–104B specification. V. B.

462. Oilspread and Lubrication (1). A. H. Stuart. *Petroleum*, 1946, **9** (12), 283.—The phenomenon of oil spread and conditions influencing it is discussed. In the case of "metal to metal" contact only a few points of very small area are actually on contact. Molecular attraction extends for only a few Angstrom units, whereas the irregularities on the best metal surface finish are usually of the order of 100 times this amount. Where the separation is small enough for molecular forces to operate, what may be regarded as "local welding" takes place. This is the basis of seizure.

The coefficient of friction of metals measured under ordinary laboratory conditions is nearly always less than one, but the surfaces tested are not those of the metals themselves, but of films which form on them (due to adsorbed gases, *e.g.*, oxygen, metallic oxides or moisture and dust). When de-gassed, pure clean metals are used, very high coefficients of fractions are obtained, often of the order of 5 or 6 and with gold, approaching 30.

The relative motion between two metal surfaces appears quite smooth but with suitable apparatus it can be shown to consist of a series of jerks ("slip-stick" motion) with unlubricated metals as well as in the presence of some lubricants. This is probably due to the formation and rupture of the welded bridges produced by intermolecular forces at certain points The object of lubrication is to secure a lubricant-film sufficiently thick to keep the bearing surfaces apart. At high loads and low speeds, as with gear wheels and cold pressing, the film cannot be maintained. These conditions may arise in abnormal circumstances in a bearing where full-film lubrication is normal, when a sudden rise in load or temperature reduces the viscosity below the safety margin. The thin film left may be only one or two molecules thick and the term "boundary conditions" has been applied to this state. The function of the oil is quite different from what it is with normal lubrication. If the temperature rises further, the boundary film will be unable to carry away the heat generated in the bearing and seizure will probably occur. The ability to leave a tenacious boundary film when the bulk of the oil has been squeezed out is termed "oiliness." Vegetable oils possess it in a higher degree than mineral ones, but a mixture of the two combines this advantage with the stability of mineral oils. Adding from 1 to 2% of fatty acid is usually satisfactory. For extremely high loads other additives may be necessary, *e.g.*, sulphonated oils, chlorinated waxes, and lead soaps. K. C. G. K.

463. Principles of Filtration. 4. The Case of Colloidal Graphite. A. H. Stuart. *Petroleum*, Nov. 1946, **9** (11), 262.—Colloidal graphite as a lubricating oil additive has become of major importance during recent years, especially for running-in engines and under conditions of abnormal temperatures and loading. In the majority of filters the interstices are much larger than the particle size of colloidal graphite, but filters retaining the graphite and passing clear oil can be made, *e.g.*, an edge filter with paper discs packed under sufficient pressure. However, as graphite is very responsive to surface activity, filters of the adsorbent type also retain graphite contained in lubricating oils. In such cases the filtering septum adsorbs a certain maximum quantity of colloidal graphite but thereafter little further loss need be expected.

Details are given of a test made to ascertain whether colloidal graphite, like amorphous carbon, will act as an emulgent to produce a water-in-oil emulsion. No such emulgent properties were found. Evidence is also given indicating that the passage of a graphited oil through a given filter is usually higher than the plain oil under the same conditions. K. C. G. K.

464. On the Main Types of Oil and Gas-Bearing Platform Structures. N. J. Uspenskaya. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **53**, 347 (in English).—Local uplifts which complicate the structure of large platform arches and basins are subdivided into three groups: (*a*) buried structures, (*b*) surface structures, (*c*) salt domes. Group (*a*) is discussed in detail and further subdivided into "revived" and "compacted" structures. The geological characters, oil and gas contents, and conditions for gas and oil occurrence of these two subdivisions are tabulated, together with actual examples. Group (*b*) surface structures are briefly defined. 6 references. G. H. B.

465. On the Rolling of a Cylinder Over a Surface Covered with a Viscous Layer. N. A. Slezkin. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **52**, 573 (in English).—Starting from the well-known equations of Osborne Reynolds' theory of lubrication, expressions are derived connecting the tractive force, fluid film thickness, angular velocity of rolling and viscosity of the fluid for the system defined by the title of the paper and used to obtain the coefficient of rolling friction. Complete and approximate expressions are also given for the case where the cylinder executes pure sliding motion without rotation. G. H. B.

466. Steam Turbine Lubrication Problems and Their Solutions. 3(1) Cooling Function of the Oil. Alan Wolf. *Petroleum*, 1946, **9** (12), 277.—In a large modern turbo-generator set the heat to be extracted from the oil is of the order of 2 million B.Th.U. per hour, and the combined loss from fraction and heat transmitted to the bearings is estimated at about 1/3% of the rated horse-power of the turbine.

Failure to extract heat from the oil sufficiently rapidly might result both in the weakening the mechanical strength of the bearing and in lowering the viscosity of the oil in the bearings to such an extent that the oil film could no longer support the rotor journals.

Because of moderate bearing pressure and high peripheral journal speeds oils with viscosities as low as 130–140 S.S.U. at 110° F and 40 sec at 210° F may be used in direct drive turbo-generators, but any substantial reduction in viscosity would be dangerous, due to frictional heat. The rate of oil circulation is also important. The capacity of the oil tank is now usually based on a circulation period of 5 min. There are a variety of designs for oil coolers. In the earlier types the tubes were usually of the U type but most modern equipment has straight tubes, which are easier to clean. This type usually resembles the parallel tube condensers met with in petroleum refineries (the tubes being horizontal). In another type the oil is pumped in succession through two adjacent vertical cylinders and cooled by water flowing counter-current. This design is sometimes found to tolerate remarkably large amounts of sludge with no apparent falling off in efficiency. K. C. G. K.

467. Industrial Emulsions. E. H. Kadmer (trans. by E. J. Barth). *Refiner*, 1946, **25**, 351.—A series of emulsions are described for use in metal cutting, grinding, boring, etc. New emulsifiers and methods of preparation are given. In one series of tests it was shown that when making mineral oil emulsions it appears that greater amounts of emulsifier are consistently needed as the viscosity of the mineral oil increases. In a second series of tests it is shown that certain "inherent polar bodies" present in commercial and especially in unrefined oils greatly aid in obtaining good emulsions. It appears that with such oils the emulsifier functions more efficiently. No stable emulsions are possible (after several weeks' standing) with highly refined oils using the normal amount of emulsifier. The quantity of emulsifiers used are already quite high. In a third series of tests the relation is shown between stability and type of dispersions when the system graphite plus oil is emulsified. Several methods of preparing graphite emulsions are given. G. R. N.

468. Manufacture and Use of Lubricating Emulsions. L. Boisselet. *Rev. Inst. Franç. Pétrole*, 1946, **1**, 97.—The lubrication of railway locomotives by water-in-oil emulsions was a successful economy measure adopted in France during the war. The water content of such emulsions can be as high as 50%, whilst the amount of emulsion used for lubricating does not exceed the normal consumption of straight mineral oil, thus showing a considerable saving of the latter. Emulsions can be prepared by using thinner oils than the cylinder oils normally used for steam engine lubrication, despite the high water content the pour-point can be as low as − 20° C; the emulsions are stable in storage. They exhibit thixotropic properties. A variety of emulsifying agents can be used; unless, however, a calcium soap is employed for this purpose, the water used for preparing the emulsion should be fairly soft. Emulsification can be produced either mechanically or by the use of steam. Three main types of emulsion were prepared: (*a*) lime water, fatty oil, mineral oil, fatty acid, (*b*) water, blown fatty oil, wool wax, mineral oil, (*c*) steam, blown fatty oil, wool wax, mineral oil. The procedure for preparing emulsions of these types is described. It is suggested that if superheat temperatures were to be raised above those now in common use, emulsions such as these would be the only lubricants that would resist decomposition. It is urged that the use of such lubricating emulsions should increase, in order to economize the consumption of scarce high-grade mineral oils. An editorial note suggests that emulsions could be employed in the lubrication of refrigeration compressors.

V. B.

469. Hub-Wedge and Curve Greases. A. E. Hickel. *Refiner*, 1946, **25**, 518.—Manufacturing methods and testing for these greases which are used in railroad equipment are discussed. The Hub-Wedge grease is a straight lime-base grease without fillers or additives. The Curve grease is also a lime-base grease containing a specific amount of micronized graphite. The pour-point of the oils used in the Curve grease ranged from − 65° F to − 20° F with low viscosity necessitating a small amount of E.P. additive.

G. R. N.

470. The Hypoid Gear. P. H. Moore. *Petroleum*, 1946, **9** (12), 282.—The development of the hypoid gear is traced and the extent to which it is used in the American motor-car industry is indicated. Before the war very few British cars used this gear, but its use will probably spread, creating a demand for hypoid gear oil. K. C. G. K.

Bitumen, Asphalt and Tar.

471. A Mobile Hot Asphalt Plant. Anon. *Engineer*, 1946, **182**, 562.—A number of interesting features are incorporated in a mobile hot mix tarmacadam and asphalt plant, capacity 20 tons per hr. The plant consists of 3 main units, viz., feeding, drying, and mixing, each mounted on pneumatically tyred wheels. The units are jacked off the ground when in use, and the wheels stored. The feeding unit handles two grades of aggregate by belt conveyor to a rotary dryer 18 ft long by 4 ft diameter, heat being supplied by two high pressure oil-burners mounted in a dual combustion box at the discharge end of the dryer. A fan at the other end of the dryer extracts hot gases. A gear pump mounted on the dryer framework draws bitumen from independent boilers which are arranged singly or in groups, as required, at the side of the plant. The dried aggregate is elevated to a 12 ft by 3 ft Oscillex screen, and weighed into a 1 ton paddle mixer with cement filler and bitumen from a weighed tilting bucket. Control doors from the various compartments are pneumatically operated from a central control cabin. The plant is driven by a 60 h.-p. oil engine. A. C.

Special Hydrocarbon Products.

472. Aromatic Hydrocarbons from Petroleum. The Catarole Process. Anon. *Petroleum*, 1946, **9** (11), 252.—A brief review of some of the main points of the Catarole process for the simultaneous production from an essentially non-aromatic charging stock (such as naphtha or gas-oil) of the whole range of aromatic hydrocarbons in substantially pure form. In addition, a valuable gas mixture containing a high proportion of olefines is produced. K. C. G. K.

473. Field Experiments with Heat-Generated Aerosols. R. Latta. *Economic Entomology*, Oct. 1946, **39**, 614.—Results of study of the behaviour of aerosol clouds when applied to forested areas in New England, 1944–45 are given.

The larvæ of the gypsy moth, *Porthetria dispar* (L.) was used as subject for control. Two thermal generators were used, an army oil–fog generator and a Hochberg–La Mer aerosol generator.

The aerosols were generated by adding D.D.T. dissolved in *cyclo*hexanone to the oil supply of the generator.

Successful applications depended on a steady wind of 10 m.p.h. or more above the forest canopy, or one good inversion with an evening air drainage down a mountain slope.

Complete mortality of the larvæ was obtained at a depth of 800 ft with 0·138 oz D.D.T. per front ft.

The Hochberg–La Mer generator produced a deposit possessing repellent properties. G. A. C.

474. Modified Aerosol Formula for Use Against Mosquitoes and Houseflies. A. H. Madden, H. O. Schroeder, E. F. Knipling, and A. W. Lindquist. *Economic Entomology*, Oct. 1946, **39**, 620.—The basic D.D.T. aerosol formula (5% D.D.T. plus 10% of *cyclo*hexanone) for use against malaria mosquitoes and houseflies was modified by addition of fatty materials or of wetting agents. Fatty materials used included propylene glycol monoleate, propylene glycol monolaurate and oleic acid; and wetting agents used were *Vatsol OT* (dioctyl sodium sulphosuccinate) and *Nopco* 1216 (sulphonated sperm oil).

There was no material increase in the effectiveness of the basic formula.

Motor oil was found to be as effective as sesame oil in the pyrethrum aerosol (0·4% of pyrethrins) containing 8% of oil, and it also increased the effectiveness of the D.D.T. formula. Results were independent of the viscosity of oil used.

A formula containing 3% D.D.T., 5% *cyclo*hexanone, 5% motor oil, and 0·3% pyrethrins was developed. This is relatively stable at low temperatures, safe to use in presence of plastics, and is equally effective against both mosquitoes and houseflies. G. A. C.

475. Plastics from Petroleum. 4. Statistics. W. S. Penn. *Petroleum*, 1946, **9** (11), 266.—Tables of production figures for past and present years (including those for synthetic rubber), both in the United Kingdom and the United States are given and discussed. K. C. G. K.

476. Molecular Weights in Practice and Theory. I. Practice, 2(1) Physical Methods. A. V. Brancker. *Petroleum*, 1946, **9** (11), 250.—The following methods are discussed: those of Dumas and Victor Meyer, and the cryoscopic (Beckman) method, with various modifications as regards stirring and temperatures measurement. K. C. G. K.

Derived Chemical Products.

477. Petroleum. Raw Material for Organic Synthesis. G. E. Villar. *Bol. del Inst. Sudamericano del Petroleo*, 1946, **2**, 355.—A general survey of progress in chemical synthesis from natural and cracked gases during the last 10 years, together with production statistics of the various derivatives. The article is profusely illustrated with photographs of American plants, and a bibliography of 20 references is included. A. C.

478. Basic Oxygenated Chemicals from C_1, C_2, and C_3 Paraffins and Olefins. J. and C. Walker and H. L. Malakoff. *Oil Gas J.*, 21.12.46, **45** (33), 59.—The four principal approaches in the production of oxygenated hydrocarbons from natural gas or refinery gases are: (1) direct oxidation, (2) dehydrogenation followed by oxidation or hydration, (3) oxidation to CO and hydrogen and hydrogenation of the CO, (4) chlorination followed by hydrolysis. Production and market data with respect to oxygenated products are given and their production from natural gas and or refinery gases, and other sources is shown in diagrams. The City Services Oil Co., at Tallant, Okla., installed

the first commercial plant in 1936, employing direct oxidation and have since expanded commercial production and recently added 3 new plants. They were the first to use ion exchange in this field and in this way met the rigid specifications for low acidity formaldehyde set by the resin and plastics industry. The activities of other U.S. concerns in these fields are discussed and the names of the firms, location, and types of plants and products made are given. Future oxidation processes covering the Fischer-Tropsch and related processes are outlined and discussed, and processes for making actylene and its oxidation derivatives, by silent electric discharge and high-temperature cracking of hydrocarbon gases, now in pilot plant stages, are outlined. Reference is made to the Shell Co's likelihood of manufacturing glycerine from propylene, and the U.S. Technical Missions work on the production of ethylene from ethane, by its partial oxidation, as employed at Leuna during the war. W. H. C.

Coal, Shale and Peat.

479. Swedish Method of Manufacturing Liquid Fuel from Low-Grade Shales. S. V. Bergh. *Oil Gas J.*, 28.12.46, **45** (34), 250.—One of the methods now used in Sweden to produce oil from naturally occurring low-grade shale, involving low-temperature distillation is described.

The plant consists of retorting and condensing units with auxiliary power and sulphur plants. Retorting of the crushed shale is carried out in a large number of small heat-controlled retorts; hot cake residue from the distillation is burnt as fuel.

The sulphur plant separates H_2S from the distilling gases and produces elemental sulphur from the H_2S.

56,500 brl of crude oil is produced from 213,839 tons of shale per year, and 3200 tons of sulphur is recovered. Cost of extraction is slightly above pre-war oil import prices. Tables show costs, properties of products produced and monthly production. G. A. C.

480. Substitute Fuels in Australia. J. Fielder. *Gas Oil Pwr*, 1946, **41**, 460.—In the absence of petroleum deposits in Australia, experiments have been made on substitute fuels for motor vehicles. Charcoal, used as a source of producer gas, was sold in briquette form, some 400,000 tons being consumed annually. The cost of conversion was about £50.

Methane obtained from a disused coal-mine could be used without purification. The heat content was 970 B.Th.U. and the total impurities 3%. Working pressure was 1800 p.s.i., and the cost of conversion was £95.

Town gas of average calorific value 550 B.Th.U. was used at a pressure of 3000 lb. H. C. E.

Miscellaneous Products.

481. Caustic Solutions. W. L. Nelson. *Oil Gas J.*, 7.12.46, **45** (31), 119.—No. 122 in the Refiner's Notebook series tabulates the specific gravity and weight % of NaOH of caustic soda solutions for temperatures from 60° F to 212° F and percentages of NaOH from 0 to 50%. G. A. C.

482. New Synthetic Organic Insecticide: Hexachlorocyclohexane. M. Raucourt and R. L. Bouchet. *Chim. et Ind.*, 1946, **56**, 449.—The insecticidal value of hexachloro*cyclo*hexane (H.C.H.) was first observed in France in 1940–41. The chemistry and industrial manufacture of H.C.H. is briefly discussed, as well as the relative toxicity of the various isomers. A list (not claimed to be complete) of various agriculturally undesirable insects that are susceptible to H.C.H. is given. A bibliography of 26 references (mainly to French work) is appended. V. B.

483. The Gelation of Petrol for Use as a Flame-Thrower Fuel. J. N. Gregory. *Jour. Council for Sci. and Ind. Res.* (*Australia*), 1946, **2** (19), 153.—A description is given of the work carried out in Australia in the development of a gelling agent for petrol for flame-thrower fuels.

The Australian army required that the gel should be capable of being rapidly prepared in the field from ordinary transport petrol, so that the British method requiring

special warming equipment for the petrol was not suitable, while the material used by the U.S. was not available in sufficient quantity.

An aluminium oleate containing 10% Al_2O_3 was found to give the best all round gelling and handling properties and when this material was stirred with petrol in about 5% concentration it rapidly swelled. In a few minutes a gel was formed which became homogeneous in a few hours. The aluminium oleate of certain closely defined chemical and physical properties was prepared by precipitation from an alkaline sodium oleate solution with alum at 60–80° C, can be represented by the formula $Al(OH)_{1\cdot3}(C_{17}H_{33}COO)_{1\cdot7}$ and is believed to be a mixture of the mono-hydroxy dioleate and the di-hydroxy mono-oleate. The addition of 2% β-naphthol (added in the caustic soda) eliminated possible oxidation and facilitated rapid drying.

The effect of various conditions affecting stability of the gel are discussed. The compound, under the name of "Geletrol," was developed to full-scale production and was considered to be one of the most effective methods of overcoming Japanese bunker defences. T. M. B. M.

Engines and Automotive Equipment.

484. New American Light Engine. Anon. *Aeroplane*, 1947, **72**, 16.—Some information is given on a light inverted 4-cylinder air-cooled engine produced by the Cameron Engine Corporation (U.S.).

Leading particulars are as follows: Dimensions: Length 45·1 in; Width between engine mounts, 13½ in. Weights: A little more than 1¼ lb/h.p. Performance: Max. power 125 h.p. at 2500 r.p.m., or cruising power 110 h.p. at 2200 r.p.m. I. G. B.

485. Cold Starting. Anon. *Flight*, 1947, **51**, 41.—Data on cold starting have been collected by a committee of the S.A.E. Aeronautics Division.

For satisfactory starting at sub-zero temperatures the following requirements must be met: (1) the engine must be turned over at an adequate speed, (2) sufficient power must be available for two 30-sec cranking periods, (3) a combustible mixture must be delivered to the cylinders, (4) an adequate spark must be produced, (5) the engine must receive a usable lubricant, (6) fits and clearances of mating surfaces must be such that normal functions occur irrespective of the temperature. I. G. B.

486. Soviet Aircraft Engines. Anon. *Flight*, 1947, **51**, 86.—Details of representative operational types are given under the headings: type; no. and disposition of cylinders; cooling; bore; stroke; capacity; compression ratio; output; r.p.m.; boost; fuel consumption at take-off, nominal and service ratings; octane number of fuel; weight; width; height; length; aircraft fitted. I. G. B.

487. Water Injection in a Spark-Injection Engine. W. P. Green and C. A. Shreeve. *Trans. Amer. Soc. Mech. Engrs*, 1946, **68**, 541.—The recent war witnessed a revival in the use of water as a coolant and detonation suppressor inside the engine cylinder. Aircraft engines when operated with water injection have been boosted in output above normal sea-level capacity and have functioned satisfactorily. This paper gives a review of past tests on the use of water as a coolant and detonation suppressor in gasoline engines. It presents new data regarding the use of water in very high-compression ratio engines to promote increased part-load efficiencies with low octane fuels.—(Author's abstract.)

488. Diesels and the Oil Industry. A. W. McKinney. *Petrol. Times*, 28.9.46, **50**, 1012.—Diesel engines are rapidly replacing gas engines and steam boilers in oilfield operations owing to the increasing value of natural gas in repressuring projects and as a raw material. The 5 general applications of diesel engines in the oil industry are: (1) drilling operations, (2) pumping and repressuring wells, (3) pipeline operations, (4) refining operations, and (5) exploration and transportation vessels and vehicles. These are briefly discussed. R. B. S.

489. Low Temperature Starting. Anon. *Gas Oil Pwr*, 1946, **41**, 463.—Research was carried out on the best means of starting I.C. engines at low temperatures: 0° F for use on the Continent and — 40° F for use in Russia. Since with many fuel oils the necessary reduction of pour-point temperature also reduced the cetane number, the fuel specification had to be carefully laid down. The grade of lubricating oil was SAE 20W.

To determine whether engines would run satisfactorily on the fuel specified, single-cylinder engine tests were made. They showed that the effect of cetane number on ignition delay could be neglected. Gumming, severe at 75° F jacket temperature, disappeared at 115° F. The fuel could not be satisfactorily handled by the injection pump until the pressure of the feed system was raised to 15 p.s.i. and the felt filter elements replaced by 140-mesh gauze. As an aid to starting the induction air was heated by a small pressure oil-burner in the intake pipe, as near to the cylinders as possible.

It was found that ease of starting was increased by retarding the injection by 7°, but the start was indefinite. Increased quantities of fuel at starting was also beneficial. Promoters, such as amyl nitrite, ethyl nitrate, and ether, were used successfully, but no single method was completely satisfactory. A starting system incorporating all the methods mentioned, together with a device for allowing the starter to remain engaged after firing had commenced, was finally adopted. H. C. E.

490. Measurement of Smoke in Diesel Engine Exhausts. C. J. Goode. *Gas Oil Pwr*, 1946, **41**, 469.—When in a C.I. engine the fuel is not completely burnt the combustion efficiency falls off and carbon particles appear in the exhaust gases. Since these two properties are intimately related, combustion efficiency can be rated by the appearance of the exhaust gases. Visual observation of the smoke is imprecise, and the method of staining a white fabric, although more accurate, becomes very tedious when the amount of carbon is assessed.

A photo-electric cell can be used to measure the smoke density of the exhaust gases. The apparatus consists of a photo-electric cell and lamp situated at opposite ends of a tube through which either exhaust gases can be blown, or pure air drawn. The power of the lamp is adjusted until a constant intensity of light reaches the photocell with pure air in the tube, and the decrease in intensity when smoke passes through the instrument gives the smoke density according to the equation:

$$\text{Smoke density per unit length of smoke column} = \frac{100}{s} \log \frac{L_0}{L}.$$

Where L_0 and L are intensities of illumination through air and smoke respectively, and s is the effective length of the smoke column.

In using the apparatus precautions to be taken include: Removal from the exhaust gases of moisture which would otherwise condense on the glass surfaces; attainment of atmospheric pressure in the tube; and fitting the sampling outlet at a point in the exhaust which gives a representative sample of gas from all cylinders. H. C. E.

491. New 2000-H.P. Gas-Turbine Generator Burns Bunker C Fuel Oil. T. I. Putz. *Oil Gas J.*, 4.1.47, **45** (35), 27. (*Paper presented at Annual Meeting of the Amer. Soc. mech. Engr, New York.*)—A brief description is given of the 2000-h.p. Gas-Turbine generator and its operation. The design is a simple type open-cycle system comprising only a compressor, combustion chamber and turbine which is connected through a single reduction gear to a double-armature d.c. traction type generator. The turbine generates approximately 6000 h.p. of which 4000 h.p. is required by the compressor and the balance of power is used for generating electricity. At full load the turbine and compressor speed is 9200 r.p.m. and the generator is run at 1200 r.p.m. The system is useful for a portable power plant for field work, or as a power unit for gas transmission lines, and as its total weight is only 38000 lb it is particularly attractive for driving an electric locomotive. Burning No. 6 (Bunker C) fuel oil to compensate economically for an expected thermal efficiency of its simple open cycle of 20%, at full load, the gas-turbine generator set operates at a top temperature of 135° F. W. H. C.

492. Resistance Welding in Engineering Construction. S. H. Gordon. *Trans. Inst. mar. Engrs*, 1947, **58**, 225.—The applications of resistance welding have increased enormously since the first patent was taken out in 1853. In all the modern variations

of the process, spot welding, seam welding, projection welding, flash welding, and the modifications thereof for special purposes, single-phase alternating current has been found to be the most suitable form of electrical energy, as the ranges of voltage required for the different heating conditions in resistance welding can be most conveniently covered with this current.

Special machines are constructed for the various types of resistance-welding processes and also for specific types of operations, such as rail welding and air-screw hub welding. Crankshafts can be flash-butt welded and it has been shown by various tests that the repaired crankshafts are satisfactory in service. O. M.

MISCELLANEOUS.

493. Oil Costs in the United States. Anon. *Petrol. Press Service*, 1947, **13** (11), 201.—Facts about increased costs in finding and producing oil in U.S. have not always been fully understood. This article gives an overall picture of the present situation and deals with the history of oil costs from the earliest stages. In the main it is stated that rising costs are due both to the decreasing rate of finding new oil deposits and to the increasing expense of exploration. G. P. K.

494. Organization and Operation of Refining Division of Petroleos Mexicanos. C. Corcijera. *Oil Gas J.*, 28.12.46, **45** (34), 228.—The Mexican government set up an organization to manage the entire industry, production and refining activities being divided.

The refining division controls all operations and covers all refining, administrative and technical functions, operating in 3 zones, northern, central, and southern.

A repair and enlargement programme was instituted after study of all the existing plant, and as a result output was increased and range of products extended.

The uneconomic topping unit at Bella Vista was closed.

A programme has been worked out based on estimated demand in Mexico up to 1950, and further plants and pipelines are projected. Tables show demand for products 1946–50, composition and production in mol. lb per hr of natural gasoline and crude from the Poza Rica, and estimated production from the topping, Dubbs cracking, butane isomerization, and H.F. units added to the Atzcapotyalco plant. G. A. C.

495. Official Petroleum Statistics of Bolivia. Anon. *Bol. del Inst. Sudamericano del Petroleo*, 1946, **2**, 481.—Production in the first half of 1946 was up to 186,000 brl, as against 162,000 brl for the corresponding period of 1945. A. C.

496. Official Petroleum Statistics of Brazil. Anon. *Bol. del Inst. Sudamericano del Petroleo*, 1946, **2**, 471.—Production in 1945 is given as nearly 80 million brl, about 25% increase over the previous best. Some photographs of recent drilling operations are included. A. C.

497. Official Petroleum Statistics of Colombia. Anon. *Bol. del Inst. Sudamericano del Petroleo*, 1946, **2**, 413.—Production figures show a steady increase from 1933 to 1940, then a sharp drop in 1942–43 and a recovery in 1944–45. Average production is of the order of 20 million brl p.a. or about 1% of world production. Cumulative production to the end of 1945 was over 370 million brl. A. C.

498. Research Laboratories of the U.S. Refining Industry. (Organization and Equipment.) M. T. Reis. *Bull. Assoc. Franç. Tech. Pét.*, 1946, (60), 3.—Following a brief general discussion on scientific research in the U.S. the planning of petroleum research (government, academic, and industrial) is described and the functions of bodies such as the A.P.I. and A.S.T.M. is outlined. A short illustrated account is given of the organization and layout of some typical industrial laboratories and pilot plant installations. In the equipment section of the paper a few paragraphs are devoted to each of the more important types of recent physical instruments (*e.g.*, mass spectrograph, electron microscope) with an indication of the uses to which such equip-

ment can be put in petroleum research and of the accuracy of results that it may be expected to yield. V. B.

499. National Fuel in France. Anon. *Petroleum*, 1946, **9** (12), 280.—A short article on the use of France's resources in lignite, shale, and peat for the production of oil. K. C. G. K.

500. French Motor Fuel Problem. E. G. Voiret. *Chim. et Ind.*, 1946, **56**, 423.—A discussion as to the most suitable means of providing, under present conditions, fuel for motor vehicles and agricultural tractors. Synthetic fuels are too costly and the plant is excessively vulnerable; moreover, French coal supplies are inadequate for this purpose. Solid fuel used in producer gas plants is the cheapest for road vehicles and agricultural tractors; the latter could be operated on wood fuel and on farm residues. A plea is made for the better utilization of French lignite deposits, which by gasification would yield 6–8% of liquid fuel as well as combustible gas and valuable by-products. Some of the gas could be utilized for the production of methyl alcohol (by the reduction of CO); this latter fuel is the only synthetic worth considering from the economic aspect and then only as a blending agent. Other possible indigenous fuel sources are the hydrogenation of natural asphalts (obtained by solvent extraction) and the use of shale oils. French shales are poor in oil content but, it is argued, can be profitably utilized by modern recovery methods. V. B.

501. Italian Oil Industry Soon to Resume on a Expanded Scale. A. Giordano. *Oil Gas J.*, 28.12.46, **45** (34), 210.—A review of the Italian oil industry is given.

Plans have been made to resume refining operations at certain plants and expand capacity at others. 800,000 brl of crude oil from Saudi Arabia are on route to Naples for the two refineries there. Dubbs thermal-cracking units at Venice are to be placed in operation.

The political situation in Italy explains delay in resumption of market activities.

The possibilities of erecting a Fischer–Tropsch plant at San Giovanni Valdarno is being discussed.

The future of the Italian oil industry depends on the supply of crude oil imports of which those on behalf of U.N.R.R.A. are to be exempted from duty.

A trade agreement with Hungary provides for the exchange of Italian tools and vehicles, etc., for 60,000 tons of Hungarian petroleum products. G. A. C.

502. Fog Dispersal. A. C. Hartley. *J. Roy. Soc. Arts*, 1946, **44** (4732), 22.—A description is given of the start and development of Operation "Fido" (Fog Investigation Dispersal Operations), and the contributions of the principal investigators and firms towards its successful application. The modifications and improvements of the vaporisers and burners, their testing and practical trials are described and shown in 8 photographs and diagrams. Some details are given of the diameters and lengths and of the piping, size of burner holes, and the spacing and disposition relative to the runways, operating, consumption of petrol in gallons per sq yd per hr, effectiveness in fog dispersal, cost of operating and satisfactoriness for aircraft landings. Petrol consumption ranged from 20 to 55 gal per sq ft per hr. The discussions on the paper are recorded. W. H. C.

503. Viscometric Investigation of Dimethylsiloxane Polymers. A. J. Barry. *J. appl. Phys.*, 1946, **17**, 1020.—The intrinsic viscosities of an extended series of linear methyl polysiloxane fluids, having dimethylsiloxane (Me_2SiO) as the repeating unit, have been determined in toluene solution. These values have been correlated with their mol. wt., determined chemically and by osmotic pressure and light scattering measurements. The Staudinger equation was found applicable only for fluids of relatively low mol. wt., *i.e.*, up to about 2500; for the higher polymers, the best correlation of intrinsic viscosity with number average mol. wt. was found to be: $[\eta] = 2 \times 10^{-4} Mn^{0.66}$. This held reasonably well for mol. wts. from 2500 to about 200,000. The bulk viscosities of the polysiloxane fluids were found to conform to the Flory relationship for melt viscosities; the expression: log visc.(cs at 25° C) $= 1{\cdot}00 + 0{\cdot}0123 Mn^{\frac{1}{2}}$ appears to be reasonably valid for mol. wts. above 2500. A. H. N.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	126 A
Drilling	131 A
Production	135 A
Oilfield Development	142 A
TRANSPORT AND STORAGE ...	144 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	144 A
Distillation	145 A
Solvent Extraction and Dewaxing	145 A
Cracking	146 A
Alkylation	147 A
Isomerization	147 A
Chemical and Physical Refining	147 A
Special Processes	149 A
PRODUCTS.	
Chemistry and Physics ...	150 A
Analysis and Testing	154 A
Gas	159 A
Gas and Fuel Oils	159 A
Lubricants	160 A
Bitumen, Asphalt and Tar ...	161 A
Special Hydrocarbon Products	162 A
Derived Chemical Products ...	162 A
Miscellaneous Products ...	162 A
ENGINES AND AUTOMOTIVE EQUIPMENT	163 A
MISCELLANEOUS	164 A
BOOK REVIEWS	165 A

AUTHOR INDEX.

The numbers refer to Abstract Numbers.

Adams, M. M., 512
Adkins, H., 629
Albear de, J. F., 516
Anderegg, F. O., 668
Andrade, De C., 664
Andrus, D. T., 553

Bailey, T. C., 661
Barnes, W. E., 531
Barthauer, G. L., 630
Bartleson, J. D., 620, 656
Bates, T. F., 534
Battershill, F. J., 661
Beatty, H. A., 651
Berg, L., 597, 598
Beuther, H., 587, 588
Blair, C. M., Jr., 581
Bloomquist, W. C., 548, 549
Boisblanc, D. R. de, 646
Bond, G. R., Jr., 645
Bondi, A., 663
Bonnell, W. S., 600
Breger, I. A., 626
Bressey, R. J., 661
Brooks, F., 634
Brown, C. W., 649
Burk, R. E., 620
Burns, W. W., 566, 567
Burroughs, L. C., 579
Burton, V. L., 626
Busey, H. H., 630

Cabeen, W. R., 505
Cade, G. N., 613
Cannon, M. R., 608, 672
Cole, R. C., 622
Collins, F. C., 653
Conroy, A. L., 656
Conroy, E. A., 672
Corson, B. B., 621
Crits, P. F., 669

David, H., 568, 569
Davies, E. B., 662
Day, R. J., 544
Deegan, C. J., 570
Derrig, M. J., 627
Dodd, C., 664
Donn, L., 636
Donohue, D. A., 596
Dousien, D. R., 610
Duff, D. M., 659
Dunlap, W. E., 506
Dunn, R. E., 613

Eccleston, B. H., 605
Eichner, C., 592
Eilerts, C. K., 543

Fawcett, F. S., 609, 618
Fay, P. S., 656
Field, E., 640, 647, 648
Fieser, L. F., 670
Fink, F. W., 541
Fogle, M. C., 587, 588
Francis, A. W., 601
Fred, M., 637

Gambrill, C. M., 644
Geist, J. M., 608
Gibbons, L. C., 611, 612
Gibson, J. D., 622
Gillespie, D. T. C., 635
Godsby, J., 606
Goldblatt, L. A., 654
Gooding, R. M., 605
Gordon, A. S., 590
Gorin, E., 615
Gorin, M. H., 591, 593
Griswold, J., 658
Gruver, R. M., 534

Haase, H. F., 541
Hale, C. H., 657
Hall, C. C., 602
Hall, R. T., 638
Hansley, V. L., 607
Harris, G. C., 670
Harrison, J. M., 597
Heath, W. A., 552
Heck, E. T., 536, 538
Hensbelwood, C. N., 606
Hepp, H. J., 613
Herrington, K. D., 628
Hershberg, E. B., 670
Hervert, G. L., 604
Hirsch, J. H., 589
Holbrook, G. W., 550
Holloway, C., 600
Hoss, R. L., 551
Huffman, H. M., 610
Hughes, R. V., 535, 554, 555
Hunter, A. L., 506

Ives, G. O., 510

Jackson, W. J., 540
Jasper, J. J., 628
Johnson, G. C., 609
Jones, J. P., 537
Jones, P. J., 559, 560, 561, 562, 563, 564, 565
Justice, W. H., 542

Karabinos, J. V., 612
Kay, W. B., 625
Kelly, C. I., 666
Kingston, B., 547
Kirkbride, C. G., 580
Klecka, M. E., 658
Knight, E. R., 667
Knowlton, D. R., 557
Kolthoff, I. M., 632
Kroon, B. C., 665
Kuhn, C. S., 591
Kutz, W. M., 621

Lacey, W. N., 614
LeClair, J. B., 650
Laltinen, H. A., 632, 633
Lankelma, H. P., 620
Lantz, V., 653
Lauer, J. L., 642
Lawry, T. F., 558
Lee, J. H., 639
Levin, H., 636
Lewis, C. J., 655
Lindsay, C. A., 532
Lipkin, M. R., 631
Lykken, L., 634, 641

McLemore, R. H., 528
McReynolds, L. A., 646
Mapstone, G. E., 643
Martin, C. C., 631, 642, 644
Masterson, E. C., 678
Matuszak, M. P., 622
Mavity, J. M., 604
May, D. R., 632
Metler, A. V., 650
Miles, C. B., 591
Mitchell, G. S., 599
Montgomery, C. W., 597, 598, 627
Morgan, P., 632
Morgana, M., 670
Mosher, H. S., 672
Moss, M. L., 638

Naragon, E. A., 655
Nelson, J. S., 633
Nelson, W. L., 584, 660
Newman, W. R., 586
Norman, H. S., 523
Novello, F. C., 670

Oblad, A. G., 593, 615
O'Brien, A. S., 632, 633
Offutt, W. C., 587, 588, 589
Oldach, C. S., 640, 647, 648
Oldroyd, D. M., 654
Ostergaard, P., 587, 588, 589

Pavlic, A. A., 629
Perrin, M., 592
Peters, E. D., 634, 641
Pines, H., 623, 624
Pitzer, K. S., 619
Poore, J. N., 548, 549
Porsche, F. W., 637
Powers, P. O., 671
Pray, H. A., 541
Prettre, M., 592
Putman, S. T., 638, 670

Rae, C., 556
Reamer, H. H., 614
Reed, P., 513, 515, 577
Reed, R. M., 603

Reid, E., 601
Ridley, C., 680
Rosenbaum, E. J., 642

Sage, B. H., 614
Sager, F., 594
Sawtelle, F. G., 531
Scafe, E. J., 582
Schmuck, R. F., 615
Serijan, K. T., 611, 612
Short, E. H., Jr., 524
Shrapnel-Smith, E. S., 675
Spalding, D. P., 672
Spitzer, R., 619
Spurr, R. A., 611
Stoppel, A. E., 595
Stout, C. E., 545
Strien, R. E., 672
Sullwood, H. H., 505
Sumner, G. L., 598
Sykes, J. K. W., 606
Teichert, C., 520
Trimble, H. M., 646
Tuemmler, F. D., 641
Tunnicliff, D. D., 641
Tuttle, R. C., 504
Tuttle, R. B., 679

Wackher, R. C., 623, 624
Walsh, A. D., 617
Ward, C. C., 605
Warner, B. R., 627
Weber, G., 508, 529, 533
Wendell, C. B., Jr., 652
West, R. V. O., 658
Wilkinson, W. R., 651
Williams, N., 521, 526, 530
Wilson, G. M., 539
Wisenbaker, J. D., 527

Yuster, S. T., 534, 544

Zetterholm, E. E., 604

Oilfield Exploration and Exploitation.

Geology.

504. Andarko Basin Prospects. R. C. Tuttle. *Oil Wkly*, 22.7.46, **122** (8), 37.—In its broadest sense the Anadarko basin includes the Dodge City basin, and covers 140,000 sq ml in 4 States. It is bounded by the Barton Arch, Nemaha–Oklahoma City Ridge, Wichita–Amarillo uplift and the Sierra Grande Uplift of Colorado. Few wells have tested the Ordovician which will be over 10,000 ft deep throughout much of the basin. The reserves of recoverable oil have been estimated at 5,000–10,000 million brl.

Thick beds of evaporites make difficult the recording and interpretation of geophysical data. Possible reservoir rocks include the Clearfork, Wichita–Albany, Pontotoc, Deese, Hoxbar, Dornwick Hills, Springer, Strawn, Tonkawa, Layton, Cleveland, Cherokee, Chester and Lower Mississippian, Misener, Hunton, Viola, Simpson, and Arbuckle.

There are major unconformities in the section. A thick Mississippi limestone section will occur over much of the basin, and the same is true of the Hunton. Along the northern margin of the Wichitas is a relatively broad zone of complex block-faulting. This zone has given the Cement, Apache, and Gotebo fields. Several tests on the southeast flank of the basin have shown beds which could be productive in favourable structural positions farther out in the basin. The Bartlesville unconformity sand produces at South Moore. The Britton and West Edmond pools on the east flank of the basin have several producing zones which could produce further west. The Tonkawa and Layton sands show traces of oil, and the Chester produces in Blaine County. Gas and distillate have been obtained from a Middle Pennsylvanian sand in Harper County. Lenticular sands in the Clear Fork have shown oil and gas in Beckham County. The basal conglomerate of the Permian–Ordovician contact produces at Hobart and Gotebo.

The dominant trends of the basin run northeast–southwest, but there may be modifying cross-trends roughly parallel to the Wichita–Amarillo uplift. In the south the mountain trends are dominant.

Deep tests costing $100,000–200,000 will be needed in this area.

There are several maps and cross-sections. G. D. H.

505. California Basement Production Possibilities. W. R. Cabeen and H. H. Sullwood. *Oil Wkly*, 22.7.46, **122** (8), 17.—The first true schist production in California was found in the western part of the El Segundo pool where the fractured schist is overlain by shale. Initial outputs up to 4500 brl/day were obtained. In 1944 prolific basement production was found at Santa Maria Valley in the fractured partly metamorphosed "Knoxville" (uppermost Jurassic). Some wells penetrated the Knoxville for over 1000 ft, obtaining oil in cores at the bottom. In 1945 the basement schist at Edison was penetrated for 100 ft, oil being found in the cores, and production was obtained. Several schist production wells have been completed at Wilmington; there are about 90 at Edison.

So far as is known all the Californian oil-producing districts are underlain by products of the Nevadan orogeny (intrusions and metamorphics) or by Franciscan–Knoxville rocks (uppermost Jurassic) consisting of sandstones, shales, cherts, lavas, intrusives, and schists. There are probably other types of basement.

At El Segundo a schist ridge is buried by Miocene and Pliocene sands and shales in which the arching dies out upwards. Part of the area is covered by a mantle of schist

debris up to 100 ft thick, and this produces in the eastern part of the field. This zone is thickest in a low area on the schist "high." In the "bald-headed" area wells found oil in fractures in the schist. Some wells produce from the schist or schist conglomerate alone, and others from both. Weathering and hydrothermal waters may have aided in the formation of the schist openings. The average schist penetration is 100 ft but some wells have gone in 300 ft.

At Santa Maria Valley a southwest-dipping monocline of Pliocene is truncated by more gently dipping Pliocene. The Miocene rests on basement sandstones, shales, serpentine dykes, and sills, all fractured, and possibly having a weathered mantle of detritus. The first basement well was a mistake, but obtained 10,000 Mcf/day and 2500 brl of oil. Some of the later wells have gone 1200 ft into the basement. Production is erratic. The oil is of Miocene origin. The top of the basement in the central part of the field is 1800 ft higher than the lowest Miocene production.

Wilmington is a broad, faulted, northwest plunging nose on which Pliocene and Miocene overlie the basement. The lower part of the Miocene is missing over certain high schist areas. 1200–2000 brl/day wells have been completed in the schist. In places the breccia overlying the schist is over 100 ft thick.

At Edison production was from Pliocene and Miocene sands in which trapping was by lenticularity, faulting, or buttressing against a schist basement "high." Some wells have penetrated the schist for more than 1000 ft. Oil and water distribution in the schist is erratic. The oil may have come from the Miocene and Pliocene. In some places weathered impermeable schist may seal the oil in the schist.

In each of the fields the schist oil resembles that of the upper zones.

Only 24 of California's 169 oilfields have wells which have reached the basement, and testing seems to have been restricted to 7. Santa Maria basin and the east side of the San Joaquin basin offer the best chances of basement production within reasonable drilling depths.

A table lists the fields where basement has been reached, and there are diagrams of some of the producing schist areas. G. D. H.

506. Drilling in California's West Newport Field. W. E. Dunlap and A. L. Hunter. *Oil Gas J.*, 10.8.46, **45** (14), 95.—The extent of the West Newport field is not yet fully established. Since 1904 some 53 wells have been drilled in this area, which has complex geology, but the discovery well was completed only in 1943. Some 74 wells give a total of 5800 brl/day. All but two of the wells produce from the "B" zone; two wells produce from the "C" zone. On the east of the Santa Ana River the wells are 1500–2050 ft deep, and have an average completion time of 5½ days; on the west the depths range 2300–3100 ft deep and are completed in 14–20 days. Costs average $17,000 per well in the former area, and $27,500–35,000 in the latter area. The proven "B" zone area is 490 acres. This zone averages 120 ft of sand with an estimated recovery of 522 brl/acre ft. The "A" sand has 80 ft of sand with a like estimated recovery.

Pico and Repetto overlie the Puente (Upper Miocene) which is the producing formation. A limited gas accumulation occurs in the "E" bed of the Middle Pico; trapping may be by faulting and by change in permeability. The "E" bed lies on the bevelled edges of the organic Repetto beds. The upper 400–500 ft of the Puente consists of brown shales and siltstone with occasional lenses of silty oil sand. Beneath this lie the oil sands.

There is a northwesterly plunging nose truncated by the Inglewood fault system. The main Inglewood fault is normal and downthrown to the south. The throw ranges 300–2000 ft in this area.

The oil sands are fine to coarse, with high porosity (over 30%) and permeability (average 1284 md). The sands are loose, and gravel packing is employed.

G. D. H.

507. Relationship of Crude Oils and Stratigraphy in Parts of Oklahoma and Kansas. Research Committee, Tulsa Geological Society. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 92.—The Tulsa Geological Society has been carrying out an extensive investigation of the relationship of crude oil and stratigraphy during the past 10 years. Several hundred analyses have been made of crude oils from a number of Palæozoic zones, ranging from the Upper Arbuckle limestone of the Ordovician to Pennsylvanian sands.

The localities from which the oil samples have been drawn are northeastern Oklahoma and southeastern Kansas. This paper summarises the results obtained to date.

It is suggested that the environment of the source material may have determined the nature of the oil in each field. For example, the variable environment of deposition of the beds at the top of the Arbuckle limestone has given rise to a great variety of oils in this formation. On the other hand, the Burbank sand was deposited under relatively constant conditions, and its oil is consequently of the same type in all the Burbank pools.

Structural movements do not seem to have changed the character of the oils, nor is the present depth of burial significant in this respect. E. N. T.

508. TXL is Representative of New Pre-Permian Fields ; Promises Major Reserve. G. Weber. *Oil Gas J.*, 24.8.46, **45** (16), 81.—Oil was discovered in the upper chert of the Devonian in 1946, and this led to the discovery of Ellenburger oil in 1945. There are secondary production possibilities in three other pre-Permian and three Permian horizons. 69 Devonian wells and 32 Ellenburger wells have been completed, and 2,500,000 brl of oil produced.

There is an elongated north–south pre-Permian anticline. A major north–south fault marks the eastern edge of production. In late Pennsylvanian time there was erosion which exposed the Devonian. The Permian shows relatively little dip compared with the deeper beds. The crest has two pre-Permian domes and minor faulting. Devonian production is limited to the west by absence of fracture and permeability.

A thin section of black Mississippian shale occurs on the west flank. The bulk of the Devonian production comes from a dense highly fractured chert. A low-permeability Devonian limestone is oil-saturated but not commercially productive, while the lower Devonian chert is stained. The top of the mid-Silurian includes the oil-saturated Fusselman chert and limestone which produced in drill-stem tests. The McKee and Waddell sand members of the Middle Devonian show oil. The Ellenburger includes chert and dolomite and has a high potential where fractured. The Wichita and Wolfcamp of the Permian have been tested for oil. The Clear Fork is productive.

Devonian and Ellenburger production cover about 3500 acres. Porosity and permeability are erratic, and reserve estimates difficult to make. Using Big Lake as a yardstick the TXL reserves are placed at 100,000,000 brl.

Brief notes are given on drilling and production techniques. Pressures have fallen from 3234 p.s.i., to 2820 p.s.i., and the saturation pressure is believed to be about 2800 p.s.i. in the Devonian. Gas–oil ratios average about 968 cu ft/brl. The Ellenburger, on the other hand, has a pronounced water drive maintaining pressure at about 4060 p.s.i. The gas saturation pressure is 2633 p.s.i. Ellenburger wells average 1049 cu ft/brl. G. D. H.

509. Oil Discovery is Recorded for Central Alberta Plains. Anon. *Oil Wkly*, 1.7.46, **122** (5), 15.—Imperial Oil's Provost 1 has discovered oil in a Lower Cretaceous sand at 2534–2549 ft. Production is at the rate of 60 brl/day of 21–22° A.P.I. oil and 165 Mcf of gas. The well lies 60 ml southeast of the Viking–Kinsella gas area.

Imperial Oil's Kinsella 14 found oil in a drill-stem test of the Viking sand, but failed to shut off gas and water from an upper member of the Viking. G. D. H.

510. Colombia Wildcatting. G. O. Ives. *Oil Wkly*, 1.7.46, **122** (5), 3 (*International Section*).—Wildcat drilling in Colombia is increasing. In Velazquez 1 in the Upper Magdelena Valley a production test is to be made at 7254–7274 ft. The sand is similar to the Guadas Sans Tertiary sand, but it may be Cretaceous or transitional. Other production in the Magdalena Valley is from the Miocene, Oligocene, and Eocene.

Sardinata 1 and Zahina 1 are just south of the Yondo concession in which the Casabe field lies. Costarica 1 in the Lower Valley region has reached 8760 ft and is preparing to test Miocene and possibly older beds. Numerous sands have been reported from 2300 ft to the base of the Miocene at 6300 ft. Most of them have had oil or gas shows which have not been tested.

Tubara 1 is to be drilled just west of Barranquilla. Tibu 21-K is 10,555 ft deep and preparing to test the Cretaceous. Chorrea 4, northwest of Bogota, hit basement granite at 7025, and is now preparing to test upper formations. The Sinu field has two

producers. Chafurray 4 was abandoned in basement at 2342 ft. San Martin 2 had 14-gravity oil in a 200-ft pay just above 6820 ft, but not in commercial amounts.

The Casabe field now has 42 producing wells. G. D. H.

511. Ecuador: Two Firms Lead Oil Search. Anon. *Oil Wkly*, 1.7.46, **122** (5), 6 (*International Section*).—International Ecuadorean Oil Co. has drilled 7 wildcats. Bajada 1 went to 13,206 ft but failed to show gas or oil. All but two of the wells have exceeded 7000 ft in depth. Shell's Vuano 1 had non-commercial showings of heavy oil.

During the first quarter of 1946 the Ecuadorean oil production was 580,460 brl. G. D. H.

512. Guatemala Oil Possibilities. M. K. Adams. *Oil Wkly*, 1.7.46, **122** (5), 8 (*International Section*).—The first recorded geological study of El Peten, Itzabal, and associated areas on Guatemala was made in 1860. A limited survey was undertaken in 1925, and a comprehensive survey in 1935 and 1936. This work, associated with an aerial survey, also included a study of British Honduras. Shell, the organizer of this latest work, was unable to conclude concession negotiations and withdrew. In 1944, Standard sent in a party, but again concessions were not taken up.

El Peten has the same beds as occur in Tampico, Texas, and the Yucatan Peninsula. A series of northeast–southwest striking faults runs in an east–west line marked by Rio San Pedro, Lake Peten-Itza, and Lake Yasha. South of this line are folds. In the Alta Verapaz the sedimentary series of Peten is upturned against igneous rocks.

Nearly all the area is covered by limestones ranging in age from Carboniferous or Permian to Miocene. On the west there are marine and non-marine Tertiary shales. The oldest limestone is shattered and has a petroliferous odour. Seepages have been reported. Cretaceous limestones rest on the Carboniferous or Permian. They are possibly equivalent to the Tamasopa limestone of Mexico. Next follows the Oligocene limestone.

In El Peten closed structures are known near Santo Toribio and Chinajo. The former strikes southwest and is faulted on its northern flank. Source and reservoir rocks are believed to be present. The Chinaja structure is better closed but less accessible. Its strike is west, and its dips steep. Production of oil might be from the Cretaceous.

About a third of the Department of Itzabal has petroleum possibilities. The same formations occur as in El Peten and British Honduras. There are folds, but any production is likely to be deeper than in El Peten. G. D. H.

513. Socony-Vacuum Explores Barinas, Venezuela's Largest Concessions. P. Reed. *Oil Gas J.*, 10.8.46, **45** (14), 62.—Socony-Vacuum holds concessions covering 3,339,700 acres in Barinas and the adjacent states of Apure and Tachira. Early in 1946 five seismograph parties and one gravity meter party were working on these concessions. Two rigs are drilling and 3 wells have been completed. 1 San Vicente was drilled 105 km southeast of the town of Barinas. It was abandoned dry at 7082 ft. 1 Silvestre was abandoned dry below 10,000 ft; it lay 60 km southeast of Barinas. Previously Sinclair had drilled a well to 5525 ft between Barinas and Barinitas.

The Barinas basin is believed to be fairly narrow and deep near the mountains. To the southeast the formations thin towards the Guayana shield. A number of seeps are believed to be associated with questionable Eocene beds. In most of the area the younger Tertiary is covered by Quaternary.

Barinas is difficult of access and transport is expensive. A short description of the means of transport and of the drilling practices in this area is given. G. D. H.

514. Venezuelan Test Promising. Anon. *Oil Gas J.*, 17.8.46, **45** (15), 73.—2 West Tarra at Los Cerritos produced at the rate of 2100 brl/day of 47·5° A.P.I. oil at 6820–6855 ft. G. D. H.

515. Many Sands, Variety of Crudes Complicate Exploitation in West Guara, Venezuela. P. Reed. *Oil Gas J.*, 24.8.46, **45** (16), 66.—West Guara is in the Greater Oficina area where production is from the Oficina formation (Miocene) It is on the southern flank of the Eastern Venezuelan Basin. The reservoir rocks are broad sheet-like sand bodies

rising to the south and southwest. Accumulation is due to faulting, wedging out, and reduction of permeability. All the Greater Oficina fields have lenticular sands with varying permeability and porosity, but most of the West Guara sands are blanket sands. Dips are 2–4°, and steeper at depth. East Guara has dips of 5–15°, and Oficina has dips generally under 2°. At Oficina gravity drainage seems to be effective in association with dissolved gas drive. At West Guara gravity drainage should also aid since the dips are higher, and there is high permeability.

Oficina has 33 producing sands, West Guara 31, and East Guara 21. In addition West Guara has 15 sands yet to be exploited, 8 tar sands and 3 dry and water sands. West Guara has light waxy crudes (37–58°), non-waxy crudes (20–42°), and tar oils (10–18°), the gravity generally decreasing with depth. The gravity may vary within a single sand and may decrease in going down the structure from the gas cap (in one case 36·9° to 23·2° 65 ft lower).

At Oficina there is complex faulting. Wells separated by faults may give different oils from a single horizon. The West Guara fault has a throw of 175–500 ft and the throw increased with depth. Production is found north of the faults whether they are downthrown or upthrown on that side. Some production occurs south of the faults, but it is spotty and relatively unimportant.

Mene Grande's portion of the West Guara field has a potential of 60,000 brl/day, and a current output of 48,000 brl/day. There are dual- and triple-zone completions. Wells were drilled on a 42·3-acre grid, but it is clear that this spacing is too wide for effective drainage. G. D. H.

516. Stratigraphic Palæontology of Camagüey District, Cuba. J. de Albear. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 71.—In the Camagüey chromite district there are late Jurassic to Eocene sediments which fall into a southern shallow water group, and a northern deeper calcareous group. The northern facies has been thrust extensively over the southern sediments and their associated serpentines. Faunal lists are given for each formation present, and the lithologic units are described. E. N. T.

517. Pogue Places Future Oil Finds at 490 Billion Barrels. Anon. *Oil Gas J.*, 3.8.46, **45** (13), 59.—Pogue has estimated future Middle East discoveries at 150,000 million brl and Russia's future discoveries at 100,000 million brl. Future discoveries elsewhere are placed as follows: U.S.A. 50,000,000,000 brl; Caribbean area 65,000,000,000 brl; Far East 58,000,000,000 brl; Europe (apart from Russia) 8,000,000,000 brl. The total future discoveries for the world are given as 490,000,000,000 brl. Currently proved reserves are estimated to total 65,800,000,000 brl, 27,000,000,000 brl being in the Middle East and 21,000,000,000 brl in U.S.A. G. D. H.

518. Important Commercial Field Indicated South of Suez. Anon. *Oil Gas J.*, 3.8.46, **45** (13), 61.—The SUDR wildcat and geophysical data are believed to point to an oilfield of considerable commercial possibilities. It lies 4 ml inland. G. D. H.

519. Additional Concessions are Given Anglo-American. Anon. *Oil Wkly*, 1.7.46, **122** (5), 48 (*International Section*).—The Anglo-American Oil Co. has recently been granted further prospecting licenses covering 1790 sq ml. Gringley 1 has passed 3000 ft. Belton 1 was abandoned at 5459 ft. Well 6 at Midlothian has been deepened to sands which were gas-bearing in Well 1, but the sands were thin, and gave little gas. G. D. H.

520. Stratigraphy of Western Australia. C. Teichert. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1.—The area of Western Australia is about 1 million sq. ml. Within this enormous area are found sediments of all the major geological systems except the Silurian and possibly the Triassic. These sediments occupy or underlie not less than one-third of the total area.

This paper describes and classifies the sedimentary occurrences and describes the three major basins with thicknesses of more than 10,000 ft of sediments. Of these three major basins, one is little known and the other two are geosynclinal in type. They are the Desert Basin, in which there is probably 14,000 ft of sediments ranging from Devonian to Jurassic; and the North-West Basin with 14,000 ft of Permian to Tertiary strata.

There is an abundance of potential source, reservoir, and cover rocks in these sedimentary basins and they are interesting from the point of view of oil accumulation.
E. N. T.

Drilling.

521. Mobile Rotary Drilling Unit Proves Efficient in Rocky Mountain Operations. N. Williams. *Oil Gas J.*, 1.2.47, **45** (39), 50.—A portable unit is described. The unit as designed is capable of drilling an 8-in hole to a depth of 1000 ft and a smaller hole to a depth up to 1500 ft. It has drilled as much as 750 ft in a single day, and in one test it made 100 ft in 1 hr. During another series of tests it drilled 6380 ft of hole in 21 days' drilling time, or at the average rate of more than 304 ft daily including moving and shutdown time. The first 3100 ft of this was drilled in 11 days' drilling time. In another case, it drilled and completed a 134-ft water well with casing in 2½ hr. All equipment is truck mounted. Present units utilize a standard 1½-ton Ford truck with 158-in wheel-base, although almost any 1½-ton truck is adaptable. Various shop alterations are made, including installation of a special muffler, heavy-duty bumpers and running boards, safety-tread flooring, and a new-type radiator-hood cowling to provide maximum engine cooling effect. Screw-operated steady jacks are provided to support the rear of the drill and relieve the truck springs and tyres of load while the unit is on location. These are hinged to the truck frame under each side of the rear and fold up against the truck bed when the rig is in transport. Simplified control design, a hydraulically operated "pull down" for weight control on the bit and for lifting pipe, a new design for slips and break-out tongs, and utilization of standard Ford truck drives, differentials, and universal joints (Spicer) are among the more important innovations. Through utilization of the latter standard truck units, parts for replacements are available almost anywhere so that nearly all minor repairs can be made quickly. The entire rig is designed in unitized sub-assemblies which can be removed and replaced easily on location with new or rebuilt mechanism. These features combine to minimize shutdown time and permit drilling of more hole. Individual components are described in some detail. A. H. N.

522. Lateral Drilling Project. Anon. *Oil Gas J.*, 21.12.46, **45** (33), 68.—A well bottomed at 1720-ft was used to drill lateral drainage holes into an oil sand using Zublin turbine bit on flexible pipes and curved joints to deflect the well. The turbine bit assembly consists of three main parts: (1) the housing which carries the nozzles of the turbine; (2) the shank member carrying the turbine runner mounted on ball bearings within the housing, and (3) the cutter element which is mounted on ball bearings and is free to rotate about an axis which is inclined with respect to the axis of rotation of the shank. The cutting action of the bit is credited to the tendency of the bit to cut opposing teeth in the formation facing the teeth of the cutter. If the bit were hanging free, the cutter would rotate at approximately the speed of the turbine or about 4000 r.p.m. However, as the cutter face is forced against the formation, these "rock" teeth retard the rotation of the cutter by the ratio of 1 to 10. The cutter speed is thus about 400 r.p.m. about its inclined axis compared with 4000 r.p.m. of the turbine and shank. The cutter, however, "wobbles" at the rate of 4000 times/minute, owing to the inclination of the cutter axis. The 1-to-10 reduction is attributed to the placement of the cutter teeth, which are designed to remove one-ninth of the opposing "teeth" in the formation on each revolution of the turbine or the corresponding "wobble" of the cutter face. The cutting action of the bit depends in part on the tendency of the cutter teeth to lift and drop the bit. The entire bit has an overall length of 20 in to permit the drilling of curved holes. Fluid pumped down the hole inside the pipe is discharged near the cutter teeth. Construction of the bit provides for disassembly and reassembly to permit replacement of turbine parts if worn by abrasive action of the drilling fluid.

Orientation of the bit is made in two ways, one using a Zublin magnetic compass and the other by a surveying method. These are described. A. H. N.

523. Modern Portable Units in Drilling and Well Servicing. H. S. Norman. *Oil Gas J.*, 30.11.46, **45** (30), 77.—Portable drilling units designed for speed of erection, dismantling, and removal are described. Telescoping masts, available in various

heights, form an integral part of the portable units. Hook capacity of the masts ranges from 70,000 to 250,000 lb. Racking capacity of the masts ranges from 4600 ft of 2½-in tubing to 13,000 ft, depending on length of stands and design of the mast. The Harbor company's new unit, for example, has a 90 ft mast and a net hook capacity of 200,000 lb. Racking capacity is 12,000 ft of 2½-in tubing in 60-ft stands. When collapsed for moves, the mast is 52 ft long. The mast is raised by hydraulic jacks or rams and travel block mounted on the semi-trailer unit. Bubble levels secured to the side and front of the mast are typical of attention given to small details which contribute to the speed of positioning the unit. Another similar facility is the use of pull-lift hoists in securing guy lines to the deadmen anchors. This ratchet arangement for securing the mast in plumb position permits speedy first installation and affords a simple means of correcting for stress conditions which may arise during drilling or servicing operations. A. H. N.

524. Drilling Barge Designed for 15 ft Water Operation. E. H. Short, Jr. *Oil Gas J.*, 23.11.46, **45** (29), 62.—Specifically designed for the job, a barge is being used to drill in 14 ft of water in Gulf Coast waters, which is believed to be the deepest barge operation without shell matting. The barge is 140 ft long, 50 ft wide, by 16 ft deep. The layout of the equipment and method of operation are described. A. H. N.

525. Big Diesel-Electric Barge Drilling Rig. Anon. *Oil Wkly*, 30.12.46, **124** (5), 28.—The most powerful diesel-electric barge drilling rig used by Humble Oil and Refining Co. is described. Details of size, power, and capacities are presented and the rig illustrated photographically. A. H. N.

526. Diamond-Bit Coring in the Rangely, Colorado Field. N. Williams. *Oil Gas J.*, 4.1.47, **45** (35), 48.—Results of several experimental uses of diamond coring in the field are presented and discussed. Actual cutting time (exclusive of trips, etc.) with diamond bits has run from 8 to 12 mins/ft as compared with an average of more than 45 min/ft for conventional coring. Conventional coring time ranges from around 20 min up to as much as 270 min/ft. Cuts have averaged from 150 to 175 ft/head against 6–8 ft, for conventional-type heads. In one case, the record, a total of 544 ft, was cut with a single head. With 25, 30, and 50-ft cores being cut, the high footage/bit has resulted in fewer round trips and consequent substantial savings in trip time (about 6–8 hr/trip) in addition to the reduction in actual coring time. Moreover, by using a 6¼-in bit (full hole size), no reaming has been required which in itself is a substantial saving. So far experiments with employing reverse circulation with diamond-bit coring have not proved entirely satisfactory. Attempted in only one well, a total of 80-ft was cored by this method but the cores tended to clog up in the catcher after cutting 10 to 12 ft and could not be pumped out. When reverse-circulation coring is perfected it is expected that cores will be pumped to the surface as cut and the number of round trips further reduced, and possibly that the need of trips will be eliminated if one bit can core the entire section. Reverse circulation also is expected to make for faster and better coring by more effective removal of the cuttings from the bit. Conventional and diamond coring methods are studied side by side and compared. A. H. N.

527. Quick Freezing of Cores. J. D. Wisenbaker. *Oil Gas J.*, 25.1.47, **45** (38), 275; *Oil Wkly*, 20.1.47, **124** (8), 42.—To avoid loss of water, oil, and gas from cores when they are taken from the field to a distant laboratory for tests, a method of quick freezing was evolved. The application of quick freezing was believed to be a practical method of preserving the fluid content of cores, because freezing effectively anchors each particle of oil and water in the particular part of the core it occupies on being taken from the well. Some concern was felt, however, over the effect quick freezing might have on permeability, porosity, and other physical characteristics of oil- and gas-bearing rock. A drastic alteration of the sample was not expected because the particles of water are dispersed throughout the core and the expansion due to freezing is cushioned by the oil and gas content of the core. Porosity was not expected to change appreciably because even with considerable internal fracturing, which might cause a substantial change in permeability, no solid matter would be added or removed. Tests were conducted on cores fully and partially saturated with water. It was found

that (1) Samples fully saturated with water and with permeability less than 10 md show an average increase in permeability of 47·5%. (2) The permeability of samples with less than 10 md and with 10·9% average gas saturation show an average increase of 1·86%. (3) Samples fully saturated with water with permeability of more than 10 md show an average increase in permeability of 0·35%. (4) Samples with more than 10 md and average gas saturations of 16·0 and 32·8% show an average increase in permeability of 3·06 and 2·54% respectively. The much smaller effect of freezing on samples with over 10% gas saturation may possibly be due to the fact that water expands approximately 9% on freezing.

Tests data are presented on fresh sand cores before and after quick freezing.

A. H. N.

528. Casing Perforating With Shaped Explosive Charges. R. H. McLemore. *Oil Gas J.*, 28.12.46, **45** (34), 268.—The principle of the shaped explosive charges consists of leaving a cavity, or air space, in the explosive, at the spot where maximum force is required. In the casing-perforating charges, the explosive is placed in a plastic container, leaving a cavity in one end. An air space is formed by the nose end of the container and the interior of a conical metal cavity liner, against which the explosive rests. The diameter, angle, thickness, and material of the liner all have a bearing on the size of the hole formed by the detonation, and on the total depth of penetration. In the tests described, the average diameter of the entrance hole for the normal charge was ½-in; for the heavy charge ¾-in. The hole is made by an extremely high-velocity metallic jet caused by the detonation of the explosive. This jet is emitted from the conical liner as it is progressively collapsed by the detonation wave of the explosive. Following behind the jet is the collapsed cone, referred to as the "carrot."

Details of several tests on cemented casings perforated by these charges with different metal liners are given and discussed. Clean-cut holes are obtained.

A. H. N.

529. Coated Drill Pipe Proves Successful in Permian Basin. G. Weber. *Oil Gas J.*, 1.2.47, **45** (39), 40.—A plastic-coated pipe has been tested in drilling corrosive salt sections of the Permian basin for the past 14 months and appears to be successful in preventing drill-pipe failure from corrosion. Plastic coating, now widely used to protect metal surfaces from corrosive action, is possible only on the interior surface of drill pipe. No known plastic will resist the abrasion and shock applied to the outside of such pipe in service. However, such an external coating would add little further protection from corrosion, since the same abrasive action which makes such a coating impractical, also retards formation of corrosion pits by wiping them off the minute they get started. Therefore, a stable well-bonded internal plastic film, resistant to water, oil, mild caustic and other chemicals, and normal mud abrasion at temperatures up to 400° F will provide sufficient protection to warrant the additional cost. The tests on the newly developed internally coated pipe are discussed in some detail and a general analysis of the results shows it to be a successful practice. A. H. N.

530. Abnormal Gas Pressures Controlled. N. Williams. *Oil Gas J.*, 30.11.46, **45** (30), 60.—Gas pressures of 9200 to 9500 p.s.i. were encountered in 2 wells drilled in South Texas; they were controlled by mud weight. High pressures has been expected in drilling these wells but it was not anticipated they would be nearly as high as they were. Consequently, in drilling the first well their control necessitated adoption of some emergency measures and procedure devised as the conditions arose. A further complication in this well was occasioned by the fact that its drilling programme originally was designed for a depth objective of only 10,000 ft. When mud weight had to be built up to control pressures, running of an extra protection string of casing had to be resorted to in order to prevent loss of circulation in the upper formations. This forced such a reduction in hole size for the deeper drilling that operations were greatly handicapped. Knowledge of the excessive pressures and formational conditions gained in the first well prepared the company for what to expect in the second well. Accordingly, a somewhat different drilling programme was formulated for this well. Special practices were devised and extra precautions taken to insure maximum drilling control and safeguard the hole while negotiating the high-pressure zones. As a result, this

well was drilled without undue incident and hole completed in a minimum of time, as compared with the first well. Details of the procedures are given. A. H. N.

531. Value of Continuous Mud Weight Records in High Pressure Drilling Operations. F. G. Sawtelle and W. E. Barnes. *Oil Wkly*, 6.1.47, **124** (6), 30.—A new mud-weight recording device now available provides both a continuous record and also a continuous indication of the mud weight on derrick floor. This new mud-weight recorder and indicator is remarkably simple in its principle of operation. The device consists of a vertical cylindrical tank through which the mud is pumped by means of a specially designed diaphragm pump. In the side walls of this tank are two neoprene diaphragms so placed that the mud contacts one side of each diaphragm, while the opposite side is enclosed by a fluid-filled diaphragm cap. The fluid chambers of the two diaphragm caps are connected by fluid-filled lines to opposite sides of the mercury chamber of a recording manometer of the type used to record the differential pressure on orifice meters. The vertical distance between the diaphragms is selected so that the differential hydrostatic head, as recorded by the manometer, will cover the full chart range of the meter, as the mud weight varies from that of water up to 20 lb/gal. The pulsations in mud flow through the recorder tank, caused by the reciprocating diaphragm pump, serve to break the gel of the mud so that no auxiliary stirring device is necessary. The continuous mud-weight recorder is furnished with a device for indicating mud weight on the derrick floor to insure that the drilling crew be immediately warned of any unusual fluctuations in mud weight. This device is electrical in nature, and draws its power from a small dry battery which operates the indicator for a period of 6 weeks to 2 months before replacement becomes necessary. The mud weight is indicated on a large meter, easily readable at 10 ft. The meter may be mounted in any convenient place near the driller's working position. The weight indicating mechanism is driven by the pen shaft of the mud-weight recorder, and is carefully designed so that it does not detract from the accuracy of the recorder system. The apparatus is photographed. A. H. N.

532. Recovery of Barite from Rotary Drilling Mud by Centrifugal Separation. C. A. Lindsay. *Oil Gas J.*, 14.12.46, **45** (32), 92.—The centrifuge described is for continuous feed and discharge of separated products. The usual heavy drilling mud contains three solid constituents: bentonite or clay, sands of 2·6 specific gravity, and barite or witherite (4·4–4·6 sp. gr.) which is usually available at a sp. gr. of only 3·9–4·2. Bentonite or clay normally consist of colloids and particles small enough to be held permanently in suspension. The + 200-mesh sands are largely removed by combined chemical conditioning and screening whereas the — 200-mesh barite is held in suspension by adjusting gel strength and viscosity to counteract the settling tendency. During drilling operations the mud is continually becoming contaminated with excess colloids, cuttings, sand, oil, gas, and salt, from the formation encountered. Where oil, gas, and salt-water contamination is excessive the barite consumption is usually excessive. By the simple expedient of fresh-water dilution to reduce the viscosity and decrease the gel strength, drilling mud can be conditioned for centrifuging after the cuttings and + 200-mesh sands have been removed. The centrifugal operation consists in separating barite as a heavy concentrate and rejecting lightened mud containing slimes and contaminating fractions. Efficiency of this separation varies from 85 to 95% recovery of the weighting material, depending upon variations in feed, weight of desired concentrate, and g.p.m. throughput. A certain amount of fine sand in the feed will find its way into the barite concentrate, but actual field experience discloses that the percentage is small and of slight consequence. The operation of the centrifuge and details of testing it are presented. A. H. N.

533. Sodium Chromate Used in Permian Basin Drilling to Combat Salt-Water Corrosion. G. Weber. *Oil Gas J.*, 7.12.46, **45** (31), 103.—Although laboratory immersion tests show that a sodium chromate concentration of 1000 p.p.m. reduces corrosion of steel samples in salt-water muds by 94% in practice, the proportion used in drilling muds ranges from 1800 to 3000 p.p.m. and averages 2000 p.p.m. Most drillers mix 50–100 lb of chemical to about 50 gal of water in a common oil drum or chemical mix tank. It is added slowly, in the amount calculated to give the desired proportion, at the rate of about 50 gal/hr into the flow line, either before or after the shale shaker. The

proper concentration can easily be checked by colorimetric titration using dropper bottles, recording the results either directly in p.p.m. or lbs/brl. Once the mud has been brought to the desired concentration of sodium chromate, small daily additions will serve to maintain proper proportions. The principal mud service company in the Permian basin performs this service for many of the rigs using the inhibitor.

Cost studies are given for the U.S. A. H. N.

Production.

534. Clay Content of Oil Sands. T. F. Bates, R. M. Gruver, and S. T. Yuster. *Producers' Monthly*, Aug. 1946, **10**, 16.—It has previously been shown that the homogeneous fluid permeability of formation samples to air is often different to that of the same samples to water: this effect must not be confused with the relative permeability–saturation relations in heterogeneous fluid flow. It is believed that certain complex silicate clays present in sands undergo physico-chemical reactions with water in contact with them, causing them to swell and reduce the permeability of that sand to water. The reduction in permeability must therefore depend on: (1) The extent of swelling of the particular clay in contact with the particular type of water; (2) The quantity of clay present in the sand; (3) The distribution of the clay in the sand.

The three methods which are described for the analysis of clay content of sandstone are: (1) The differential thermal analysis method; (2) The X-ray spectrometer method; (3) The electron microscope method.

The samples are prepared in the same way for all three methods by extracting with naphtha, breaking down to grain size, and passing through a series of sieves of 400 mesh: the corse fraction is discarded. These samples are then mixed with water into a paste and elutriated in water to reduce the quantity of quartz minerals present.

The first method consists of measuring the temperature difference by means of a differential thermocouple between a clay sample and a thermally inert substance, both of which are being heated simultaneously at an equal and constant rate. Any chemical or physical changes in the clay involving a liberation or absorbtion of heat will create a temperature difference between the clay and the inert substance. This produces a differential temperature versus actual temperature curve which is a characteristic of the clay minerals present.

In the second method the sample is subjected to a stream of X-rays at a continuously varying incident angle. The intensity of the diffracted beam is measured simultaneously at the same angle as the incident beam with a Geiger counter. This produces a curve of scanning angle versus intensity of diffracted beam which is characteristic of the material being tested.

The third method consisted of taking highly magnified pictures with the electron microscope. The shape and size of the materials was studied as a means of identification of the minerals present.

The study of some particular samples from the Bradford sand by these methods indicates that Illite was the commonest clay mineral found in this particular sand with smaller amounts of Kaolinite and Montmorillinite also being present. Of these, Illite and Montmorillinite swell in the presence of water, and hence they could be responsible for a reduction in water intake rates in water flooding.

The strong exothermic peaks shown in the differential thermal curves are indicative of the presence of organic materials which may be polar compounds: these would have an effect on the wettability of the sand. They are strongly adsorbed and difficult to remove by simple extraction. Further studies on these substances are suggested in view of their importance in oil production. One reference is given. R. B. S.

535. Secondary Recovery Production Research (A Monthly Review): Selective Shooting Research Needed. R. V. Hughes. *Producers' Monthly*, Aug. 1946, **10**, 10.—The most important tests which should be carried out to determine the most effective selective shooting method are: (1) To test the relative merits of solid, semi-solid, and liquid explosives under conditions of fluid tamping versus solid tamping and heavy tamping versus light tamping; (2) To evaluate the benefits of being able to increase the shot volume by drilling holes of larger diameter; (3) To determine the relative responsiveness of a given shot upon well consolidated and upon poorly consolidated sands.

One advantage of the solid and semi-solid explosives recommended for well shooting

purposes is that they are safe to transport and to handle, even by relatively inexperienced persons. Solid and semi-solid explosives can be made in a wide range of rates of detonation, hence, when the relationship between rates of detonation and fracturing ability in sands of different degrees of consolidation is better understood than at present, the proper solid or semi-solid explosive to meet every well condition could be selected.

Whilst a light water tamp seems to be less efficient than a solid tamp, the cleaning out time is much reduced. In cases of low formation pressures, a hole full of water may drive dirty water into the sand immediately following the shot and thus result in some plugging of the sands. The filling of the hole with strong salt brine or a water slightly on the acid side is suggested for all water tamps. In such cases the clay and shale particles in the hole capable of causing plugging action, would be changed to and kept in a flocculated condition and could be easily washed off the sand face during the bailing operation.

The necessity of increasing research in the field of selective shooting is emphasized and the possibility of instituting new shooting methods is discussed. Eight references are appended. R. B. S.

536. Future Possibilities for Oil in New York State and the Appalachian Basin. E. T. Heck. *Producers' Monthly*, Sept. 1946, **10** (11), 25. (*Paper presented before Eastern District Division of Production, A.P.I., Pittsburg*, June 1946.)—The geological succession of rocks in central and western New York is presented and the oil prospects of New York State and the Appalachian Basin generally, are discussed. For convenience, New York is divided into three districts, each of which is studied separately. These three districts are: (1) the eastern district which includes those parts of the State where the crystalline rocks are at the surface; (2) the south-central district which includes all the oil- and gas-fields of the State at present known; and (3) the eastern district where the surface rocks are of Devonian age.

Nine references are given. R. B. S.

537. Research, Exploration, and Engineering Needs of the Penn Grade Producing Industry. J. P. Jones. *Producers' Monthly*, Aug. 1946, **10** (10), 38. (*Paper presented at annual meeting, Pennsylvania Grade Crude Oil Association, Pittsburg*, June 1946.)—The present state of the Pennsylvania petroleum industry is reviewed and suggested programmes of research, exploration, and engineering improvements are discussed. R. B. S.

538. Future of the Penn Grade Area. E. T. Heck. *Producers' Monthly*, Oct. 1946, **10** (12), 15. (*Paper presented before the Engineers' Society of Western Pennsylvania, Bradford*, Sept. 1946.)—The future of the Pennsylvania petroleum industry is briefly discussed: there seems to be a possibility that new reserves will be discovered, particularly if deeper drilling is practised. More important, however, are the large reserves of oil which can be made available by secondary recovery methods. The author believes that the oil saturations as shown by cores cannot always be used to determine the value of properties, especially outside the Bradford area, and he suggests that pilot operations give a better indication of secondary recovery possibilities. When old holes are used for input wells they should be thoroughly cleaned out, and the injection of several hundred gallons of gasoline ahead of the water is suggested, so as to remove paraffin from the vicinity of the hole and to aid in starting an oil bank in front of the water. R. B. S.

539. Laboratory Simulates Formation Condition. G. M. Wilson. *Oil Wkly*, 30.12.46, **124** (5), 33–34.—Description of laboratory apparatus for measuring sand characteristics such as porosity, permeability, etc., and of fluid characteristics such as P.V.T. data is presented. A. H. N.

540. Treatment of Gun-Perforated Wells. W. J. Jackson. *Oil Wkly*, 23.12.46, **124** (4), 52.—A thorough discussion is presented of the cleaning procedures necessary for wells which have been gun-perforated. Well treatment methods are primarily of the mechanical, hydraulic, chemical, and explosive type. The mechanical cleaners include perforation scrapers, washers, and bailers for the removal of material from the

bottom of the oil string. The hydraulic methods depend on pressure differential opposite the zone to be cleaned while the chemical methods involve the breaking down or dissolving of the material deposited in and immediately surrounding the perforations. In the use of explosives, cleaning action results from the pressure caused by the explosion transmitted laterally through the perforations. When customary completion practices are performed, including washing, swabbing, circulation with oil, pressure drilling, and reverse circulation method, with no apparent results in formation response, it is evident that the harmful effect of mud fluid, water and the formation itself in sealing and restricting the free passage of oil through the sand pores, annular space, and the perforations themselves is of principal concern. The different methods are described. A. H. N.

541. Corrosion of Oil-Well Equipment in Air–Gas Drive Operations. H. A. Pray, H. F. Haase, and F. W. Fink. *Producers' Monthly*, Sept. 1946, **10** (11), 11. (*Paper presented at annual meeting, Pennsylvania Grade Crude Oil Association, Pittsburg*, June 1946.)—The data obtained in a study of brines and air–gas mixtures used in injection operations is discussed, and analyses of these are presented in tabular form together with analyses of the various scales and deposits within the tubing. The data suggest that as the brines enter the well they may be very corrosive because of the high chloride content, dissolved oxygen, and carbon dioxide and the acid character of the water: the chemical reactions which take place with iron equipment are discussed. The most corrosive constituents of gases are oxygen, carbon dioxide, and sulphur dioxide.

A number of different methods for reducing the amount of corrosion and scale formation in oil wells were examined in detail. The most important of these methods are: (1) inhibitor additions to the brine; (2) inhibited rust preventive coatings; (3) magnesium or zinc addition to the brine; (4) galvanic (electrolytic) protection; (5) galvanized steel; and (6) alloy steels.

The most effective inhibitors for brine addition were found to be zinc or sodium chromate and sodium hexametaphosphate (Calgon), this latter also tends to inhibit scale formation. The simultaneous addition of zinc chromate and Calgon gave still better results. Inhibited rust-preventative coatings were found satisfactory and inexpensive for providing protection to those parts of well equipment which are exposed to a corrosive vapour phase: several proprietary compounds were studied. The addition of metallic magnesium to the brine increases the pH and thus slows down the attack on steel: unfortunately, this increase in pH causes calcium carbonate to be precipitated, but it was found that the simultaneous use of Calgon would keep this precipitate in such a flocculated condition that it would easily pass through the pumping system: compared with other methods, however, the corrosion rate is only slightly reduced. Zinc accomplishes as much as magnesium, but less metal is taken into solution and the precipitate of calcium carbonate is greatly reduced. Cathodic protection by the use of an external current cannot be readily adapted to an oil-well system, but the use of zinc and magnesium as sacrificial anodes was found to give protection in the immersed portions of the system adjacent to each anode. Both zinc and magnesium decreased the attack on steel, but magnesium is consumed much more rapidly than the zinc and also gives rise to a calcareous scale. Zinc was also found to reduce the attack on both brass and steel when all three were coupled together, whereas brass coupled to steel *increased* the attack on steel as much as 55%. This showed the value of insulating the brass barrel and valves of pumping assemblies from the rest of the well system, or, alternatively, providing sacrificial zincs at such places as the barrel to tubing joint. Galvanized steel was found to corrode in brines at only 25–50% of the rate for unprotected steel. Alloy steels containing 5–12% chromium resisted attack, but they are much more expensive: low alloy steels (less than 2% additions) did not outlast carbon steels. R. B. S.

542. Valuation of Gas-Condensate Reservoirs for Cycling. W. H. Justice. *Oil Gas J.*, 4.1.47, **45** (35), 72. (*Paper presented before A.I.M.M.E.* 18.12.46.)—The estimation of condensate recoveries by cycling and by straight production under pressure depletion is presented. A. H. N.

543. Gas-Condensate Reservoir Engineering. Part 1. The Reserve Fluid, its Composition and Phase Behaviour. C. K. Eilerts. *Oil Gas J.*, 1.2.47, **45** (39), 63.—There

are ten basic engineering problems to be solved when a gas condensate field is to be developed. This paper deals with the following five problems (the others are to be discussed in subsequent 2 parts): (1) Size of the fluid reserve; (2) composition of the fluid and its richness in marketable hydrocarbons; and (3) the original phase state of the fluid in the reservoir, particularly as it relates to the possibility of liquid in contact with the gas phase in some part of the formation. Depending largely on the size of the reserve and the phase state of the fluid in the reservoir, plans must be made for recovery of the hydrocarbons and answers must be found for questions relating to the following problems; (4) the progressive changes in the phase state of the reservoir fluid as pressure declines when fluid is withdrawn through producing wells; and (5) the effect of injected gas on the phases of the reservoir fluid under the practice of pressure maintenance and gas drive. Whilst the discussion, in parts, is a review of existing knowledge, it also includes original work on gas/liquid phase behaviour and on mixing of injected and original gas in the reservoir. A. H. N.

544. Gas Requirements in Gas Drive Recovery. S. T. Yuster and R. J. Day. *Producers' Monthly*, Oct. 1946, **10** (12), 21. (*Paper presented before Eastern District Division of Production, A.P.I., Pittsburg*, June 1946.)—The gas requirements in gas drive recovery are affected by pressure gradient, permeability, oil viscosity, and connate water saturation. Laboratory experiments on cores indicated that there was a linear relationship between the total liquid saturation and the logarithm of the volume of injected gas necessary to reach that saturation. These experiments also showed that: (1) less gas and less time is required to produce a given quantity of oil at high pressure gradients; (2) gas requirements appear to be independent of permeability, but more work is suggested to verify this point, especially at low permeabilities; (3) more gas is required at higher oil viscosities; and (4) gas requirements depend only on the total liquid saturation and not on the relative amounts of connate water and oil, but the higher the connate water saturation, up to certain limits, the more complete is the recovery. Consequently, it seems desirable to increase the water saturation of a sand low in connate water, provided that the water wets the sand.

An equation for predicting field behaviour is derived mathematically, and this indicates that for steady state conditions (*i.e.*, with a constant rate of gas input) the reciprocal of the oil production rate should be a linear function of the cumulative time: this is verified by field data. From this equation is derived another which shows that the cumulative production is proportional to the logarithm of the ratio of the initial and final oil production rates over the period of time involved (provided that steady state conditions persist). Other equations are derived, again for steady state conditions, which show that the gas–oil ratio is a linear function of the time and a logarithmic function of the total liquid saturation: these equations can be used to deduce the required volumes of gas to be injected per barrel of oil. Four references are given.
R. B. S.

545. Electrically Operated Jacks. C. E. Stout. *Producers' Monthly*, Oct. 1946, **10** (12), 12.—The type of electric pumping jacks used in the Washington–Taylorstown field of Pennsylvania is briefly described and the advantages of its operation in this field are reviewed. Two references are appended. R. B. S.

546. All British Invention Revolutionises Deep-Well Pumping. Anon. *Petrol. Times*, 9.11.46, **50**, 1150.—The new "N.F.B." displacement pump is briefly described. This pump is particularly adapted to the operation of stripper wells—the operating costs for this type of well having been reduced as much as 50% in some cases. R. B. S.

547. Mechanically Rotated Scraper Blades Eliminate Paraffin Accumulation in Tubing of any Pumping Well. B. Kingston. *Oil Gas J.*, 14.12.46, **45** (32), 78.—The equipment described is reported to have been tested by over thirty independent operators and found successful in preventing paraffin accumulation. The principle used is to rotate the sucker rods at each stroke and to have scrapers on some of the rods so that wax is not allowed to accumulate. The scraper blades are made of flat ¼-in soft mild steel 1½ in in width and 2 ft long, spaced 26 in apart longitudinal to the rod. The sucker rod is placed in a pneumatic jig which is equipped with pressure arms designed

to force 3 U-shaped clips around the rod and to within $\frac{1}{32}$-in of the surface of the scraper. These clips are placed one at each end and one in the centre of the scraper. Welds are then made uniting the ends of the clips to the scraper, thus effecting a strong friction grip of the scraper to the rod without impairing in any way the quality or tensile properties of the material in the rod. Rotation of the rod string is accomplished by ratchet levers attached to the lower part of the hanger body engaging teeth on a horizontal toothed table flanged directly under the hanger. The actuating lever employed to engage the teeth on the table on each reciprocation of the pump is kept in motion by means of a flexible cord attached to the arm of the lever, and running to the beam of the unit. Action of the lever is controlled by changing the position of the flexible cord along the beam. The partial rotation of the scrapered rod string on each reciprocation of the pump prevents the accumulation of paraffin. The equipment is illustrated. A. H. N.

548. Power Distribution Systems for Oilfield Pumping Service. Part 1. W. C. Bloomquist and J. N. Poore. *Oil Wkly*, 23.12.46, **124** (4), 46.—The principles of electrical motor usage for oilfield pumping are presented. Of particular interest is a practical detailed discussion of the advantages ensuing on power factor improvement by use of capacitors and the presentation of tables giving the required sizes for different conditions. A. H. N.

549. Power Distribution Systems for Oilfield Pumping Service. Part 2. W. C. Bloomquist and J. N. Poore. *Oil Wkly*, 30.12.46, **124** (5), 54.—Comparative studies on cost basis are made of the use of 440-volt and of 762-volt systems. Practical details on posts and cables are presented. A. H. N.

550. Design and Construction of Water Pumping Plants. G. W. Holbrook. *Producers' Monthly*, Aug. 1946, **10**, 32. (*Paper presented before Eastern District, Division of Production, A.P.I., Pittsburg*, June 1946.)—In the design of any injection plant the prime factors are the quantities of water to be pumped, and the pressure to be attained. Sand thickness, sand permeabilities, gas, oil, and water saturations, and well spacings, all affect the quantities of water required.

The theoretical or water horse-power (*WHP*) can be computed from the formulæ :

$$WHP = \frac{WH}{33{,}000}$$

$P = 0{\cdot}434H$, where W = weight of water to be pumped in pounds per minute, H = head of water to be attained in feet, and P = pressure in lb/sq in.

Pressure at the sand face are limited to the highest pressure which can be carried without by-passing (usually 0·8–1·4 p.s.i./foot depth to the sand). In computing the pressure at the sand face the head of water in the well, the friction losses in the lines to the well, and the difference in elevation of the well head and plant location must all be taken into account.

Considerations involved in selecting the site, designing the buildings, installing auxiliary equipment and protective devices, and in selecting the types of storage tanks, pumps, prime movers, and piping, to be used, are each discussed. R. B. S.

551. Calculated Effect of Pressure Maintenance on Oil Recovery in Fullerton Field, West Texas. R. L. Hoss. *Oil Gas J.*, 4.1.47, **45** (35), 58. (*Paper presented before A.I.M.M.E.* 18.12.46.)—Summary of calculations is given here for the future performance of the Fullerton field, Andrews County, West Texas, under primary depletion and also for two programmes of pressure maintenance by gas injection. The only driving mechanism assumed to be active in this field is solution gas. The basic differential equations employed are those developed by Muskat for analysing reservoirs possessing this type of drive. A. H. N.

552. Unitization of Oil Pools for Secondary Recovery. W. A. Heath. *Producers' Monthly*, Aug. 1946, **10**, 28. (*Paper presented at annual meeting, Pennsylvania Grade Crude Oil Association, Pittsburg*, June 1946).—The benefits of unitization and the factors influencing such an agreement are discussed. Seven references are appended. R. B. S.

553. Secondary Recovery Research. D. T. Andrus. *Producers' Monthly*, Aug. 1946, **10**, 20. (*Paper presented before Interstate Oil Compact Commission, Michigan*, Aug. 1946.)—The economic advantages to oil producers of organized secondary recovery research are discussed in detail. R. B. S.

554. Secondary Recovery Production Research (A Monthly Review): Brines are Superior Input Water. R. V. Hughes. *Producers' Monthly*, Sept. 1946, **10** (11), 9.—The results of permeability tests and recent clay analyses show that every input water should possess such physical and chemical characteristics as keep the clay content of sands in a permanently flocculated condition. This tends to prevent swelling of these clays with consequent reduction in permeability. Brines possess these properties and corrosion resulting from their use can be reduced by the removal of oxygen. In such favourable circumstances brines are more suitable than fresh water for flooding operations because: (1) input rates are increased for the same pressure; or conversely (2) are maintained at lower pressures; (3) wider well spacing can often be permitted; (4) oil recoveries from tight sands are increased; (5) the brines do not then pollute surface waters; and (6) the principle of conservation of natural resources is upheld. R. B. S.

555. Secondary Recovery Production Research (A Monthly Review): Channeling and By-Passing. R. V. Hughes. *Producers' Monthly*, Oct. 1946, **10** (12), 9.—The very factors which are the chief cause of channeling and by-passing in water-flood operations are those about which little is known; they are: (1) variations in permeability in both the horizontal and vertical planes; (2) composition of the sands as regards degree of cementation and cementing material; (3) elastic properties (which affect the response to shooting operations); (4) systems of joints, fractures, solution channels, and planes of weakness. The effect of these factors on water-flooding operations is discussed.

When oil wells are shot for increasing production the best practice is usually regarded as that which produces the greatest amount of fracturing with the minimum of shattering. The author discusses this fact and concludes that the reverse is preferable in the case of water input wells if channeling is to be kept to a minimum: this is provided that shattering does not occur to such an extent that caving occurs. The deleterious effects of too high input pressures are already well known. It is suggested, as a precautionary measure, that the well-head pressure in pounds on any new input well be limited to approximately half the well depth in feet until after the fill-up period, when pressures may be gradually increased until the desired working pressure is reached, unless signs of channeling are noted. Until more is known about the compressibility, rigidity, and elasticity of the producing formations, operating pressures approaching the critical should be approached slowly and with caution. R. B. S.

556. Repressuring in Cunningham Pool, Kansas. C. Rae. *Producers' Monthly*, Oct. 1946, **10** (12), 18. (*Paper presented before Mid-Continent District Division of Production, A.P.I., Oklahoma*, June 1946.)—The history, geology, formation characteristics, and development of the Cunningham Pool in the Lausing Lime formation, Kansas, are briefly reviewed. Gas injection has been practised in this pool for 10 years; some 84% of the produced gas having been injected inot the formation. Prior to gas injection the pressure had declined from 1100 lb to 424 lb with the production of 1,009,000 brl of oil: the fact that 2,632,200 brl of oil have been produced since gas injection was started, whilst the pressure has only declined from 424 lb to 365 lb, indicates the value of repressuring in a field of this type. The ultimate recovery is estimated as 4,500,000 brl: if gas injection had not been practised the expected recovery would have been about 2,800,000 brl. R. B. S.

557. Proper Control of Oil Reservoirs. D. R. Knowlton. *Oil Gas J.*, 28.12.46, **45** (35), 273.—Elementary principles of reservoir fluid control are discussed and terms of fundamental significance are defined. A. H. N.

558. Channeling in Water Flooding. T. F. Lawry. *Producers' Monthly*, Sept. 1946, **10** (11), 29. (*Paper presented before Mid-Continent District Division of Production A.P.I., Oklahoma*, June 1946.)—By-passing in water flooding can be divided into three

distinct classes: (1) movement of water through cracks or fissures containing very little oil (often referred to as channeling); (2) movement of water through layers of relatively high specific permeability; and (3) movement of water through layers of relatively low oil saturation. Remedial operations suitable for overcoming by-passing of types (2) and (3) are not suitable for overcoming channeling: hence it is important to distinguish between them. An easy way of doing this is to introduce a fluorescent dye into the injected water: this will be detected in the producing wells within about 100 hr if channeling is occurring, otherwise the period will be much longer; often the dye will never appear in the oil well when by-passing is occurring, but instead it becomes absorbed in the porous medium.

Channeling may be caused by injection at pressures greater than the critical (above which the overburden appears to be lifted): care should be taken to avoid this condition, since the detrimental effects in such a case are often permanent. Mixture of bentonite mud and some fibrous material were found effective in curing some cases of channeling, but in other cases a cementing job was necessary. When the channels are effectively sealed, it is necessary to clean up the sand face to prepare it for renewed injection of water. R. B. S.

559. Expansion and Free-Gas Saturation. Part 4 of Oil Production by Water. P. J. Jones. *Oil Gas J.*, 23.11.46, **45** (29), 71.—A decline in reservoir pressure down to saturation pressure is accompanied by expansion of reservoir liquid and frequently by some encroachment of water. The oil recoverable by expansion of reservoir liquid varies with compressibility, pressure decline, and volume of oil in place. The rate of water encroachment at a given time is proportional to pressure decline. At pressure less than saturation values, some oil is produced by free gas. The possible gain in recoverable oil by water at declined pressures is nominal even if a free-gas saturation as high as 10% of porosity is not displaced by water. The corresponding pressure decline is 15–25% of saturation pressure. A. H. N.

560. Producing Rate by Expansion. Part 5 of Oil Production by Water. P. J. Jones. *Oil Gas J.*, 30.11.46, **45** (30), 64.—The cumulative oil recovery by expansion may range from 5 to 17 million brl/100 million brl of oil in place. This recovery is available during the time reservoir pressure declines 15–25% of the saturation pressure for oil. The rate of production by expansion varies with the rate of pressure decline and may be of the order of several thousand brl/day. When oil is produced by expansion and water, the two producing methods interfere with each other. The oil produced by water cannot be produced by expansion and vice versa. This interference usually is not resolved in practice. Nevertheless, a breakdown for production by water and production by expansion is included here in order to illustrate the influence of declining pressures on producing rates and on ultimate recovery. A. H. N.

561. Interference Between Wells. Part 6 of Oil Production by Water. P. J. Jones. *Oil Gas J.*, 7.12.46, **45** (31), 92.—Oil production is by virtue of the drawdown between reservoir and bottom-hole operating pressures. The available drawdown for one well is 100%. But the available drawdown for two additional wells may be less than 90% even if they are located as much as 1000 ft on two sides of, and on strike with, the first well. This is interference between wells. Let n wells be located on a parallel to a water contact. Denote the available drawdown for the two by 100%. The available drawdown for another row of wells located updip from, and parallel to, the first row is only 37%, provided the wells on the second row have the same bottom-hole operating pressure as the wells on the first row and oil production is by edge water. The interference between two rows of wells is greater than between wells on one row. A. H. N.

562. Equivalent Well Systems. Part 7 of Oil Production by Water. P. J. Jones. *Oil Gas J.*, 14.12.46, **45** (32), 108.—A statistical approach to estimating the producing capacity of any number of wells is desirable from the viewpoint of the number of wells alone. In addition, statistical procedures are indicated by the many factors influencing well capacity. The approach suggested in this paper is based on equivalent 1-, 2-, and 3-row well systems. The application of average completion in pay, average permeability, and average drawdown to the wells on a first row is an approximation

to actual values. Similarly, the application of interference factors is an approximation, depending on judgment whether a given group of wells constitutes 1-, 2-, or 3-row equivalent well system. A. H. N.

563. Well Capacity. Part 8 of Oil Production by Water. P. J. Jones. *Oil Gas J.*, 21.12.46, **45** (33), 77.—The producing capacity of wells varies with the number of wells, interference between wells, completion in pay, permeability, and drawdown. The required producing rate from a given reservoir varies primarily with the per-interval acre-ft of pay. The required rate of production from one sector in a given pay interval may be much faster than that from some other sector in the same interval. The factors controlling the required number of wells are considered from the sectional and areal viewpoints. Well capacity is also considered relative to variable reservoir and bottom-hole pressure which is less than the saturation pressure for oil may be accompanied by a rapid decline in well capacity. The drilling of additional wells does not increase well capacity for reservoirs already saturated with wells. Pressure maintenance by water injection is essential to maintaining well capacity. A. H. N.

564. Displacement and Invasion for Injection Wells. Part 9 of Oil Production by Water. P. J. Jones. *Oil Gas J.*, 4.1.47, **45** (35), 53.—Production of oil by injected water is similar to oil production by encroaching water. Dry-oil reserve is proportional to the product of displacement and breakthrough invasion factors. These factors plus interference between wells are considered here as a background for the next article in which injection-well requirements and water requirements will be discussed. A. H. N.

565. A Radial Reservoir. Part 12 of Oil Production by Water. P. J. Jones. *Oil Gas J.*, 1.2.47, **45** (39), 57.—The characteristics of a radial reservoir and the capacity to produce undersaturated oil at MER by edge water are indicated. Location and spacing of producing and injection wells for the reservoir will be considered in the next article. A. H. N.

Oilfield Development.

566. World Production Approaching 8,000,000 Barrels Daily. W. W. Burns. *Oil Gas J.*, 27.7.46, **45** (12), 138.—Current world output is estimated at 7,805,800 brl/day, including an output of only 44,000 brl/day attributed to the Far East which in pre-war days gave 225,000 brl/day. At present Roumania yields 85,000 brl/day, about 50,000 brl/day less than before the war.

Outside U.S.A. the oil output is estimated to have averaged 2,766,700 brl/day in the first 4 months of 1946. The 1938 output averaged 2,119,000 brl/day, and in 1941 2,219,000 brl/day. Venezuela, Iran, and Saudi Arabia are responsible for most of the increase since 1941. Currently Venezuela gives 1,052,700 brl/day. 400,000 brl/day more than in 1941. Iran gives about 400,000 brl/day, nearly twice its pre-war figure. Saudi Arabia now yields 170,000 brl/day.

A table gives the estimated current daily output, and average daily output for the first 4 months of 1946, by countries outside U.S.A. G. D. H.

567. World Production : Gains Outside U.S. More than Offset Losses. W. W. Burns. *Oil Gas J.*, 25.1.47, **45** (38), 157.—An estimate of North (except U.S.A.) and South American, European, Egyptian, and Asiatic oil production possibilities is given, and the international situation reviewed. A table gives world crude oil production outside the U.S. and shows, for example, that oil production for Asia has been almost doubled. Russian production has been estimated at 500,000 brl daily late in 1946, as against 572,000 brl in 1938. It is calculated that the world total daily output in 1947 (excluding U.S.A.) will exceed the 1946 figure of 2,930,000 brl. G. A. C.

568. 14,522 New Wells Projected for Last Half of 1946. H. David. *Oil Gas J.*, 27.7.46, **45** (12), 140.—2006 wildcats were completed in U.S.A. in the first half of 1946, and 2561 are planned for the second half. A total of 13,742 wells were completed in the first half of 1946, and 14,522 are due to be drilled in the second half. 46,566,000 ft was drilled in the first half and 52,454,000 ft is expected to be drilled in the second half.

A table gives by States the numbers of wells of various types drilled in the first half of 1946, and expected to be drilled in the second half. G. D. H.

569. Completions up 7·2% First Half. H. David. *Oil Gas J.*, 27.7.46, **45** (12), 142.—13,746 wells were completed in U.S.A. in the first half of 1946. 2006 wildcats were completed in the same period. Texas had 3955 completions, Oklahoma 1240, and Illinois 1005. In most of the major areas there was a downward trend in average depths.

Tables summarize by States and districts the U.S. completions in the first half of 1945, and analyse the wildcat and development completion results. There are brief notes on the outstanding points in the principal areas. G. D. H.

570. 104 Major Fields Yield 54·34% of Nation's Oil. C. J. Deegan. *Oil Gas J.*, 27.7.46, **45** (12), 146.—Formerly a major field was defined as one which attained an output of 100,000 brl/day. Due to improved production technique and policies comparison of old and new fields is not practicable on this basis, and accordingly a major field is defined as one with an ultimate of 100,000,000 brl.

It is estimated that U.S.A. has 15,000 oilfields, but only 104 can be termed major. These account for 54·34% of the total oil produced to date, and had 58·06% of the proven reserves at the end of 1945. Many consider that practically all the profit in the oil industry comes from the major fields.

The major fields of Texas and California have given 11,931,000,000 brl of oil, out of a total of 17,571,000 brl for all the major fields of U.S.A. The proven reserves of the major fields in these 2 States is 10,905,000,000 brl out of a U.S. major field total of 12,654,000,000 brl. The major fields of Texas accounted for 40·5% of the total U.S. proven reserves at the beginning of 1946; on July 1, 1946, they had produced only 32·5% of the total output of all U.S. major fields, but they possessed 65·8% of the proven reserves of such fields.

The U.S. major fields are listed, with the estimated ultimate recovery, remaining reserve and cumulative production at the beginning of July 1946, and other production data. G. D. H.

571. Production by Bolivia Shows Decline in January. Anon. *Oil Wkly*, 1.7.46, **122** (5), 51 (*International Section*).—In January 1946, Bolivia produced 30,215 brl of oil (Camiri, 11,897 brl; Bermejo, 10,168 brl; Sanandita, 8150 brl). G. D. H.

572. Decline in Ecuador Oil First-Quarter Production. Anon. *Oil Wkly*, 1.7.46, **122** (5), 51 (*International Section*).—During the first quarter of 1946 Ecuador produced 580,460 brl, 11% less than in the same period of 1945. G. D. H.

573. East Central Peru Test Drilling Around 800 ft. Anon. *Oil Gas J.*, 31.8.46, **45** (17), 59.—A new well is being drilled in the Agua Caliente field, some 1000 ft south-east of No. 5 producer. Before the war 6 producers had been drilled. 45° A.P.I. oil is obtained from the Cretaceous at 1200–1350 ft. G. D. H.

574. Austria Claims Third Rank in European Oil Production. Anon. *Oil Wkly*, 1.7.46, **122** (5), 55 (*International Section*).—It is claimed that Austria is third to Russia and Roumania in oil production in Europe.

Natural gas has been developed by several wells drilled at Aderklaa on the outskirts of Vienna. It is probable that there is gas underneath the centre of Vienna. G. D. H.

575. First Quarter Iran Output Totals 33,488,000 Brl. Anon. *Oil Gas J.*, 3.8.46, **45** (13), 60.—Iran's 1945 production was 117,876,430 brl, and the 1944 production 92,919,701 brl. For the first quarter of 1946 the output was 33,488,000 brl.

In 1945 Anglo-Iranian's U.K. production was 500,794 brl while the 1944 figure was 661,990 brl. G. D. H.

576. Iranian Production Reaches New High. Anon. *Oil Gas J.*, 24.8.46, **45** (16), 65.—During April and May 1946, the Iranian oil output was 12,201,000 brl and 12,285,000 brl respectively. G. D. H.

TRANSPORT AND STORAGE.

577. Widespread Pipe-Line Expansion Under Way. P. Reed. *Oil Gas J.*, 25.1.47, **45** (38), 165.—Total pipe-line construction in the U.S.A. for 1946 totalled 7400 miles; and projects for 1947 and later total 9672 miles.

Pipe-lines construction in other countries, for example, 225 miles in Bolivia, is also under way.

Tables give mileage, diameter, status, and location of domestic crude-oil projects, large domestic products—line and principle domestic natural gas projects for 1946 and 1947. G. A. C.

578. Butt-welded Pipe-line for Natural Gas. Anon. *Engineering*, 1947, **163**, 97.—A description, with illustrations, is given of the building of a 24-in diameter natural gas pipe-line from Corpus Christi, Texas, to Cornwell, W. Va., a distance of 1265 miles. Two types of piping, seamless and electric-welded, were used, with wall thicknesses of $\frac{9}{32}$ in and $\frac{1}{4}$ in respectively. In the main, arc-welding was employed, but for 320 miles a butt-welding or "pressure welding" process was employed. Joints were made by grinding the ends of the 2 pipes which were to be connected, butting them together under pressure and heating the joint with oxy-acetylene flames. During heating the pressure is increased, resulting in a complete merging of the granular structure. The finished welds are homogeneous and on testing for tensile strength have proved to be perfectly satisfactory. G. P. K.

REFINERY OPERATIONS.

Refineries and Auxiliary Refinery Plant.

579. Disposal of Refinery Wastes. L. C. Burroughs. *Refiner*, 1946, **25**, 299.—In a general discussion on this problem it is indicated that two conditions dictate close study of the subject (1) the pressing necessity of more economical operation, and (2) the fact that political bodies continue to demand more from industry in the protection of both surface and underground waters. Particular aspects discussed are: removal of substances insoluble in water, handling of emulsions, the use of filters following the main refinery separator, objectionable solutes, their nature and recommended methods of disposal, methods of disposing and reducing the volumes of spent soda, disposal of acid sludges, disposal of spent $AlCl_3$ catalyst, and disposal of waste gases. G. R. N.

580. Desalting of Petroleum. C. G. Kirkbride. *Refiner*, 1946, **25**, 313.—A record of a pilot plant investigation to determine the feasibility of using beds of relatively fine glass fibres for desalting petroleum. The process consists of (1) washing the crude oil with water at a minimum temp. of 250° F, (2) passing the oil and water through beds of glass fibres averaging 0·00028 in. in diameter to coalesce the emulsified water, and (3) separating the desalted oil from the wash water. The wash water may be recycled in most cases to conserve heat and fresh water. Only sufficient fresh water is needed, if recycling is done to maintain the salt content of the wash water at a maximum of 3% by wt. Life of the Fiberglas packing is in excess of 2 months. It has been found that salt content can be reduced to less than 10 lb/1000 brl oil by proper control of temp, superficial velocity, and glass surface in the beds. In general, the temperature should be at least 275° F for best results. A superficial velocity of 1·0 ft per minute seems feasible for commercial units, provided the temperature remains sufficiently high to give a pressure drop of not over 5 lb/sq. in. through a single bed. A total of five individually supported beds each of 2 in depth at 6·5 lb/cu. ft. density appears to be a reasonable basis for commercial designs to provide desalting to not over 10 lb/1000 brl. G. R. N.

581. Selection and Application of Break Inducing Reagents in Doctor Treating. C. M. Blair, Jr. *Refiner*, 1946, **25**, 379.—In some experiments on the breaking of gasoline-doctor solution mixes, sodium stearate, sodium oleate, sodium abietate, and certain

Tretolite organocolloids were compared as surface-active or break-inducing agents. As a result of these tests it is observed that when a properly selected surface-active chemical is employed operational improvements include (1) quicker break; (2) lower sulphur requirement; (3) more complete wetting and subsidence of lead compounds; (4) less emulsification and loss of gasoline; and (5) less foaming during regeneration of doctor solution. The use of break-inducing agents does not, however, lessen the desirability of good control and proper adjustment of plant variables, such as degree of agitation and sedimentation time. G. R. N.

582. **Sulphur in Light Petroleum Products.** E. J. Scafe. *Refiner*, 1946, **25**, 413.—War-time production was responsible for accelerating the processing of high sulphur crudes and preference by major oil companies has been directed towards conversion of entire refineries for this purpose. Slaughter–Duggan (West Texas) crude has been studied from this standpoint as a representative high sulphur crude. The fractions contained from 0·19% by wt sulphur for light straight run to 4·15% by wt for the residuum. The first method used was based on the elimination of sulphur as H_2S by use of cold catalyst. From results with the gas–oil fraction of 1·6% sulphur the following was observed: (1) An alumino-silicate cracking catalyst without any oxide promotor is one of the most effective desulphurization catalysts. Under optimum conditions a yield of over 90% by vol product was obtained. (2) Zinc oxide type catalyst appears to give the lowest sulphur-content product of the catalysts tested. (3) The most effective carrier for the metallic oxides is one with cracking activity. The second method tried was solvent extraction using anhydrous liquid HF as the solvent. Data showed a 70% sulphur reduction with a yield of 85% by vol product of sulphur content 0·5% by wt. HF desulphurization improves the yield, O.N., and sulphur reduction of motor gasoline in the catalytic cracking of gas-oil, but there is a net volumetric loss from the two operations. The use of H.F. is restricted to virgin stocks. G. R. N.

583. **Corrosion and Pitting in Boiler Systems.** Anon. *Oil Gas J.*, 18.1.47, **45** (37), 87.—No. 269 of the *Engineering Fundamentals* series gives an account of the causes of pitting and corrosion of boiler metals. The dissolved gases, oxygen, carbon dioxide, ammonia, and hydrogen sulphide are the most common causes, electrolysis the least, and acidity of boiler water a third agent. The use of proper-type feed-water heaters eliminates all the gases except ammonia. Maintenance of feed water at a pH above 10·5 eliminates corrosion due to acidity. Pitting and corrosion due to electrolysis is similar in appearance to that caused by dissolved oxygen. G. A. C.

Distillation.

584. **Pipe-Still Outlet Temperature.** W. L. Nelson. *Oil Gas J.*, 25.1.47, **45** (38), 285.—No. 128 in the *Refiner's Notebook* series gives 4 tables showing the approximate temperature drop from pipe-still outlet to vaporizer, for 20%, 40%, 60%, and 80% vaporization in tower with seven conditions enumerated. G. A. C.

Solvent Extraction and Dewaxing.

585. **Kellogg Announces Solexol.** Anon. *Chem. Eng. News*, 1946, **24**, 3188.—A new Kellogg process is described for the separation and recovery of the ingredients of non-mineral oils by continuous countercurrent propane extraction at relatively low temperatures and pressures. The conditions (not specified) are so mild that no polymerization of the highly unsaturated glycerides or destruction of the vitamins occurs. The process is applicable to a whole variety of oils, among which may be mentioned soyabean, cottonseed, corn, linseed, tall, fish liver, and fish body oils. An important application is the recovery of quick-drying oils from sardine, herring, and menhaden oils as linseed oil substitutes. A 25% fraction with an iodine value approaching that of tung oil can be produced from sardine oil. Another product is a sterol fraction containing tocopherols and stigmasterol. The application of the process to animal fats is being studied, and it is expected that it will be possible to remove the colour bodies in this material completely and inexpensively. The ability to recover free

fatty acids from the mixed glycerides is also a feature. By way of illustration, the results from pilot plant extractions of sardine body oil and soyabean oil are quoted. L. B.

Cracking.

586. Isomerization Unit Converted to a Polymer Unit. W. R. Newman. *Refiner*, 1946, **25**, 475.—A war-time butane isomerization unit at Frontier Refining Co. was converted to a U.O.P. non-selective catalytic polymerization unit at low cost, it being necessary to install only one piece of new equipment, viz. a new filter pot. The net result of the conversion was to increase total gasoline production by 5–7% and effect substantial savings in the amount of tetraethyl lead employed. G. R. N.

587. Naphtha Polyforming. W. C. Offutt, P. Ostergaard, M. C. Fogle, and H. Beuther. *Refiner*, 1946, **25**, 554.—The Polyform process offers two important advantages for the upgrading of naphthas and low octane straight-run gasolines: (1) attractive yields of motor gasoline having A.S.T.M. O.N. of 75–80 and research O.N. of 84–93, without tetraethyl lead addition, and (2) flexibility of operation which permits either production of a maximum yield of Polyform gasoline or maximum production of a C_4 fraction rich in olefins, in addition to a good yield of debutanized gasoline. The research sensitivity, lead response, road performance, and blending properties of Polyform gasoline are evidence of its high quality. Recent data is given on the effects of the operating variables and properties of the naphtha charge upon yields and product quality, as well as a brief discussion of some of the reactions which occur in the Polyform furnace. A nomograph is presented for predicting the relationship yield and ASTM O.N. of Polyform distillates from the characterization factor and O.N. of the naphtha charge. G. R. N.

588. Naphtha Polyforming with Outside Gas. W. C. Offutt, P. Ostergaard, M. C. Fogle, and H. Beuther. *Refiner*, 1946, **25**, 563.—The Polyform process offers the means of simultaneously converting low octane naphthas and surplus refinery gas, both paraffins and olefins, into high octane gasoline. Detailed studies are presented of naphtha Polyform operations charging extraneous refinery gases. The effects of varying amounts and compositions of outside-gas charge are discussed with respect to yields and quality of products obtained with a wide range of naphtha stocks. The flexibility and simplicity of the process are emphasized especially for manipulating seasonal refinery butane balances. A maximum yield of highly unsaturated C_4 fraction can be recovered from naphtha polyforming with or without outside gas or excess refinery. C_4 fraction can be charged to the Polyform unit for maximum production of high quality gasoline. Extent of the conversion of the outside gas streams can be varied widely for optimum utilization of the available charging stock. G. R. N.

589. Operating Variables in the Polyform Process. J. H. Hirsch, P. Ostergaard, and W. C. Offutt. *Refiner*, 1946, **25**, 570.—A procedure is given with suitable examples for calculating yields, O.N., and required operating conditions in the Polyform process. G. R. N.

590. Uncatalyzed Reaction of Natural Gas and Steam. A. S. Gordon. *Industr. Engng Chem.*, 1946, **38**, 718.—The uncatalyzed reaction of natural gas with steam has been studied between 1225° and 1516° C with steam-natural gas ratios of 1·5 and 5, and time of contact between 0·21 and 4·6 sec. Even at high temperatures, long contact times, and steam-natural gas ratio of 5 there is some carbonization of the natural gas. The extent of carbonization is shown to be a function of the ratio of steam to natural gas, and to vary erratically with temperature and time of contact. As the temperature is increased, the percentages of natural gas undecomposed in one pass through the furnace become less dependent on contact time (in the range of contact times studied), until at about 1500° C there is little or no effect. At any temperature the percentage of undecomposed gas shows little if any dependence on the ratio of steam to natural gas. A. W.

Alkylation.

591. Mechanism of Catalyzed Alkylation of *iso*Butane with Olefins. M. H. Gorin, C. S. Kuhn, and C. B. Miles. *Industr. Engng Chem.*, 1946, **38**, 795.—Supporting evidence is presented for a simple mechanism which explains the products of the primary alkylation reaction of *iso*butane with olefins, catalyzed with acids and aluminium halides. This mechanism excludes certain products which are not experimentally detected in important quantities. Primary alkylation products are defined as those alkanes which are formed preferentially and in high yields at low temperatures and short residence times. Formation of these products and the secondary isomeric products is ascribed to the simple addition of methyl and *iso*propyl fragments (from *iso*butane) to the various permissible forms of an olefin-catalyst complex. A. W.

Isomerization.

592. On the Participation of Methane in the Synthesis and Transformation of Aliphatic Hydrocarbons. M. Prettre, C. Eichner, and M. Perrin. *Compt. Rend. Acad. Sci.*, 1947, **224**, 278.—It was shown in previous work by Prettre (*Cahiers de Physique*, 1941, **1**, 73) that the catalysts used in certain processes of the petroleum industry gave rise to isomerization resulting in the formation of hydrocarbons with numerous methyl side-chains. It was considered that the yield of such products would be increased by introducing a source of methyl radicles into the reaction system, and the conditions under which methane could act in this way, without the use of high pressures, were derived with the aid of free energy calculations. The results indicated that methane should participate in the Fischer process carried out at approximately 200° C and normal pressure to an extent comparable with the carbon monoxide of the ordinary synthesis gas mixture ($CO + 2H_2$). This conclusion was tested experimentally using a catalyst of reduced nickel on kieselguhr, a space velocity of 100, temperatures of 190° and 175° C, reaction mixtures with the composition $CO + 2H_2 + nCH_4$ ($n = 1, 3, 10$), and operating times up to 144 hr. The extent to which methane was consumed in the reaction was determined from the volumes and ratio of the methane contents of the product and reactant gases. This ratio was determined for each 24-hr period in five experiments, and the results obtained indicated that for all the reaction mixtures containing at least 50% methane, this gas was utilized either from the start of the synthesis or after some delay. The consumption of methane was slight at 190°, but at 175° 1 volume of methane reacted for 2 volumes of carbon monoxide, despite the excess of hydrogen in the reactants. G. H. B.

593. Isomerization of *n*-Butane Catalyzed by Aluminium Bromide. A. G. Oblad and M. H. Gorin. *Industr Engng Chem.*, 1946, **38**, 822.—Previous studies of the isomerization of *n*-butane with aluminium bromide as catalyst showed that oxygen was an outstanding promoter for the isomerization reaction. These studies have continued and have been mainly concerned with the effect of oxygen. The rate of isomerization is first order with respect to *n*-butane concentration and, at a given temperature, depends on aluminium bromide concentration, oxygen concentration, and amount of surface. The rate of isomerization decreases with time because of oxygen consumption. The factors which influence oxygen and catalyst consumption were determined, and the promotional effect of oxygen is compared to that of other substances. The mechanism of the promotion of aluminium bromide as an isomerization catalyst is discussed. It is suggested that surface is necessary to assure a polar medium in which the reactions involved can take place. A. W.

Chemical and Physical Refining.

594. Sulphuric Acid Refining in the Production of Aviation and Motor Fuel. F. Sager. *Refiner*, 1946, **25**, 275.—Sulphuric acid has two functions in connection with the catalytic cracking of petroleum: the drastic removal of olefins for the preparation of aviation base stock and the light finishing treatment of either aviation base stock or motor gasoline. Two types of treatment are of interest (1) acid washing, where there is a possibility of using spent alkylation acid, and (2) polytreating with U.O.P. catalyst

and sulphuric acid refining. Advantages of the acid treatment are said to be simultaneous desulphurization with high sulphur stocks and simplification of equipment. With motor gasoline acid treatment aims at desulphurization. A comparison of this method with catalytic refining for sulphur removal shows that the latter method is not often used for cracked stocks because the thiophen type compounds seem to be unaffected. Hydrogenation is recommended as an alternative to acid treatment for high sulphur stocks. Control of contact time and treating temperature together with centrifugal separation make it possible to limit the action of sulphuric acid to desulphurization. Data on a lignite gasoline are given to support this view. The use of sulphuric acid in refining benzol and light shale oil fractions is also discussed.

G. R. N.

595. Calculation of Number of Theoretical Plates for Rectifying Column. A. E. Stoppel. *Industr. Engng Chem.*, 1946, **38**, 1271.—By extending the equilibrium curve and operating line of the typical McCabe–Thiele distillation diagram beyond their usual limits, the operating line will be found to cut the equilibrium curve at two points, once on the chart proper, and again somewhere outside the chart. The number of theoretical plates required to operate the column may be expressed as a simple power function of these two points of intersection. A. W.

596. Heat Transfer Coefficients for Condensing Hydrocarbon Vapours. D. A. Donohue. *Industr. Engng Chem.*, 1947, **39**, 62.—A simplified form of the Nusselt equation $h_m = C(L/w)^{1/3}$ is presented for calculating heat transfer coefficients for hydrocarbon vapours condensing on horizontal tubes. This simplification results from the observation that the term $0{\cdot}955(k_l^3\rho_l^2 g/\mu_l)^{1/3}$ in the Nusselt equation is approximately constant over the usual condensing temperature range for the hydrocarbons considered. Consequently, the solution requires only that the condensate loading, w/L, be known. Application of the equation to commercial design is illustrated. A. W.

597. Azeotropic Purification of Styrene. L. Berg, J. M. Harrison, and C. W. Montgomery. *Industr. Engng Chem.*, 1946, **38**, 1149.—The azeotropic separation of styrene from ethylbenzene can be accomplished using as entrainers 1-nitropropane, the lower aliphatic monobasic acids, a number of alcohols of more than two carbon atoms, methyl Cellosolve, or water. Methods of recovery of entrainers include phase separation, solvent extraction, and pressure rectification. A comparison between the amount of the styrene recovered and the column capacity and heat requirements indicates that these factors are renitent. The low-boiling entrainers, such as water or acetic acid, had the effect of increasing the column capacity and heat requirements, whereas those boiling higher, such as 1-butanol or methyl Cellosolve, gave a poorer yield of styrene. The optimum entrainers appeared to be intermediate boiling compounds, such as *iso*butanol or 1-nitropropane. Azeotropic methods enhance the separation of styrene from ethylbenzene with respect to the quantity of styrene recovered in a given column, or with respect to the saving of column capacity and heat requirements for a given purity. By a combination of ordinary rectification and azeotropic distillation, probably any hydrocarbon impurity may be removed from styrene. A. W.

598. Octane Rating Improvement of Olefinic Gasolines by Isomerization. L. Berg, G. L. Sumner, and C. W. Montgomery. *Industr. Engng Chem.*, 1946, **38**, 734.—The olefines in an olefinic gasoline can be isomerized with a minimum of such side reactions as cracking, hydroforming, treating, aromatization, and cyclization. Optimum results are obtained at 375–425° C reaction temperature and 0·3–1·3 volume per volume catalyst per hour space velocity. The process is characterized by liquid yields in excess of 95%, usually 97–99%. The most suitable catalyst is alumina, maintained at the proper degree of activation by impregnation with anhydrous hydrogen chloride. The life of this catalyst appears to be long if the burn-off is carefully controlled so that the catalyst is thoroughly cleaned but never sintered. O.N. improvement averages approximately four units when a charge stock such as debutanized stabilized distillate is subjected to isomerization. Thermally cracked distillates are the best charge stocks because of their high olefinic content and relatively low O.N. A. W.

Special Processes.

599. Production of Ammonia from Natural Gas. G. S. Mitchell. *Refiner*, 1946, **25**, 245.—At the plant of Lion Chemical Co., El Dorado, Ark., natural gas is reformed by subjection to the methane-steam reaction. Raw hydrogen so produced is mixed with hydrogen obtained by the CO–steam reaction and purified by scrubbing with copper liquor and caustic soda. Air is introduced with the natural gas to the reforming stage to provide the requisite nitrogen for the manufacture of ammonia, which is carried out in a catalytic converter at 500° C and 5000 lb pressure. After separation from the unreacted gases and purification, the ammonia in part is oxidized by burning in admixture with air in the presence of a platinum alloy gauze catalyst to nitrogen oxides which are absorbed in water to give nitric acid. Ammonium nitrate is also manufactured. Comprehensive details are given with diagrams and photographs of the various stages of manufacture. G. R. N.

600. Pilot Plant Production of 2 : 3-Dimethylbutane. C. Holloway and W. S. Bonnell. *Indust. Engng Chem.*, 1946, **38**, 1231.—The pilot plant development for the production of 2 : 3-dimethylbutane is outlined. The alkylation of *iso*butane with ethylene by the catalyst, aluminium chloride is accomplished with the minimum of side reactions by precise regulation of the degree of catalyst-hydrocarbon contacting in a jet mixer.

The effects of hydrogen chloride concentration, catalyst activity, space velocity, mixing power, reaction temperature, *iso*butane/ethene ratio, and diluents in the feed, on ethene conversion, yields, yield efficiency, and catalyst life are discussed.

Data showing the value of the alkylate as a rich mixture blending agent are also presented. A. W.

601. Ethyl Benzene. A. W. Francis and E. Reid. *Industr. Engng Chem.*, 1946, **38**, 1194.—The ethylation of benzene with ethylene by the Friedel–Crafts reaction has been controlled so as to give yields of monoethylbenzene about 15% higher than those reported in most other investigations at corresponding mole ratios of reagents. The conditions are 100° C and ethylene pressures of 100–300 p.s.i. applied above the catalyst. These conditions also increase the reaction rate nearly a hundred-fold over some industrial processes, so that they are better adapted for a continuous operation. Yields of ethylbenzene reported in 60 investigations are correlated, and relations to mole ratios of reagents and to reaction conditions are shown. They are compared with theoretical curves for multiple-stage reactions with a common reagent. Evidence is presented that, contrary to a common opinion, the ethylation of benzene takes place at the same rate as that of ethylbenzene and other partly ethylated benzenes. Some observations are best explained by supposing that under suitable conditions the ethylation reactions are practically instantaneous. Conditions are given for making pure ethylbenzene from ethylene mixed with paraffin gases, or from a low concentration of benzene in a mixture with non-aromatic hydrocarbons. A. W.

602. The Fischer–Tropsch Process : Present and Future. C. C. Hall. *Engineering*, 1947, **163**, 54.—This article continues with a description of the preparation of the synthesis catalyst which was used in all the German plants : Co 100, ThO_2 5, MgO 8, Kieselguhr 200. Two types of plant were in general use for converting the synthesis gas, one operating at atmospheric pressure and the other at 10 atms pressure and both were designed with sufficient cooling to keep the reaction temperature between 180° and 200° C. The process was divided into two or three stages, the heavier oil products being separated in between stages and recovered by either direct cooling with water sprays or by indirect cooling in tubular condensers ; the low-boiling fractions were adsorbed in active carbon. Operation under pressure gave an increase in the proportion of higher hydrocarbons to lower hydrocarbons and in the proportion of paraffins to olefines in the primary products. The rate of passage of the synthesis gas varied between 50 to 70 volumes at N.T.P. per volume of catalyst space per hr, and the annual yield of primary products for four of the more efficient plants was 2¼ tons per cu ft of reaction space. Tables are given of performance data, average composition of reaction products, thermal balance for the process and working costs. Usually 23–30% of total heat input was recovered as primary products but was as high as 55% for the most efficient plant. A description of the fractions and their

varied use is given; it is worth noting that a small amount of the soft wax product was esterified with glycerine and sold as edible fat. 72% of the total products were used as fuels and 28% as chemical and special products. G. P. K.

603. Manufacture of Hydrogen. R. M. Reed. *Refiner*, 1946, **25**, 367.—Descriptions are given of hydrogen manufacturing processes that are in use in U.S.A. at the present time. These include (1) the electrolysis of water, (2) the steam–iron process, (3) the steam–water gas process, (4) the steam–hydrocarbon process, (5) the steam–methanol process, and (6) the thermal decomposition of hydrocarbons. The present production of hydrogen in the U.S. amount to about 6 billion cu ft per month of which about 50% is produced and utilized in the manufacture of synthetic ammonia. Flow diagrams and plant photographs are included. G. R. N.

604. Styrene Production by Catalytic Dehydrogenation. J. M. Mavity, E. E. Zetterholm, and G. L. Hervert. *Industr. Engng Chem.*, 1946, **38**, 829.—Laboratory data are presented on the catalytic dehydrogenation of ethylbenzene over a chromia–alumina catalyst in the presence of benzene. Reduction of the partial pressure of ethylbenzene by the diluent has the same favourable effects as sub-atmospheric pressures; in addition, the benzene serves as a heat carrier for the endothermic dehydrogenation reaction. Benzene is relatively stable under the conditions used and has no deleterious effect on the catalyst. Weight ratios of benzene to ethylbenzene varying from about 10 to 0 were investigated. Dilution decreased conversion at high ethylbenzene space velocities and increased it at low space velocities. At a given conversion, dilution improved styrene ultimate yield and reduced carbon formation. Reduction of pressure below atmospheric, in addition to the use of benzene diluent, further improved the selectivity of the dehydrogenation reaction. Under preferred conditions (benzene to ethylbenzene weight ratio of 5, atmospheric pressure, 3·8 ethylbenzene space velocity, and 581° C at the catalyst bed inlet) the average conversion in a series of simulated recycle runs was 34·8%; styrene ultimate yield, 89·7 weight-%.

A. W.

605. Superfractionation Studies. C. C. Ward, R. M. Gooding, and B. H. Eccleston. *Industr. Engng Chem.*, 1947, **39**, 105.—One hundred gal of naphtha representing 12% of Oklahoma City crude oil were super-fractionated in a pilot plant unit having the equivalent of 80 to 90 theoretical plates. One hundred and fifty fractions, each representing 0·5% of the naphtha, were collected between 73° and 258° F. The hydrocarbon composition of each of these fractions was determined by use of specific dispersions and refractivity intercepts, and the F-3 octane number of each fraction with 4·0 ml of tetraethyl lead was obtained. Graphs indicate the relations of composition to distillation temperatures, densities, and octane numbers. A. W.

PRODUCTS.

Chemistry and Physics.

606. The Kinetics of the Reaction of the Steam–Carbon System. J. Godsby, C. N. Henshelwood, and J. K. W. Sykes. *Proc. roy Soc.* (*Series A*), 22.10.46, **187**, 129.—The kinetics of the various reactions which may occur in the steam–carbon system are discussed. The steam–carbon reaction, the primary product of which is carbon monoxide, is of fractional order with respect to steam and strongly retarded by hydrogen. The carbon dioxide reaction is strongly retarded by carbon monoxide and is of fractional order with respect to carbon dioxide. The rates of both reactions can be represented by

$$\text{rate} = \frac{k_1 p_1}{1 + k_2 p_2 + k_3 p_1}$$

p_1 and p_2 are respectively, the pressures of steam and hydrogen for the steam reaction, and of carbon dioxide and carbon monoxide for the carbon dioxide reaction.

The water–gas reaction $CO + H_2O = CO_2 + H_2$ takes place predominantly on the charcoal surface. The forward reaction is of approximately the first order with respect

to carbon monoxide and of fractional order with respect to steam; it is retarded by hydrogen and to a lesser extent by carbon dioxide. The reverse reaction is of fractional order with respect to both carbon dioxide and hydrogen, retarded by steam and unaffected by carbon monoxide. Both components combine to give the thermodynamically correct form of equilibrium constant. H. C. T.

607. Sodium Reduction of Fatty Acid Esters. V. L. Hansley. *Industr. Engng Chem.*, 1947, **39**, 55.—An improved general method has been developed for reducing esters by means of metallic sodium. Practically quantitative yields of alcohols, based on both sodium and ester, are obtained, especially from fatty acid esters of higher molecular weight. In the classical sodium reduction procedure an excess of sodium is ordinarily added to a solution of the ester in ethyl alcohol, which functions both as solvent and as reducing alcohol. The improved method described in this paper uses theoretical amounts of both sodium and reducing alcohol, and the reaction is carried out in an inert solvent, such as xylene or toluene. The method is especially applicable to the preparation of unsaturated alcohols not easily made by catalytic hydrogenation. It compares favourably with the catalytic hydrogenation of saturated, higher fatty acid esters because of the simplicity of operation and equipment. The process can be carried out at ordinary pressure; the laboratory technique is fully described and an extensive bibliography provided. A. W.

608. Viscosities of Pure Hydrocarbons. J. M. Geist and M. R. Cannon. *Industr. Engng Chem., Anal.*, 1946, **18**, 611.—The viscosities were determined with a modified type of Cannon–Fenske U-tube viscometer. The design was such that velocities were kept low enough to prevent the kinetic energy correction from exceeding 0·2%. All samples were tested with two separate viscometers and stopwatches. The accuracy of the data was dependent upon the accuracy of the viscosity at 20° C of water which was the primary calibrating liquid; a value of 1·007 c.s. was used. The precision of the data recorded was $\pm$ 0·1% so that absolute viscosities might be in error by as much as 0·5%. The viscosities of 18 isomeric octanes are listed in tabular form according to decreasing absolute viscosity at 20° C. Many of the compounds have widely different viscosity temperature coefficients; *e.g.*, at 20° C the absolute viscosity of 3 : 4-dimethylhexane is higher than that of 3-methylheptane but at 0° C the reverse is true. In general, cyclic compounds have higher viscosities at a given temperature than paraffinic compounds with the same number of carbon compounds. The *cis* compounds have higher viscosities than the *trans* and generally the alkyl *cyclo*hexanes are more viscous than the corresponding alkylbenzenes. Viscosities have been correlated with temperature by means of the equation $\eta = A(e)B/RT$. A and B being constants for a given hydrocarbon. G. R. N.

609. Inter-Polymerization of Butenes. G. C. Johnson and F. S. Fawcett. *J. Amer. chem. Soc.*, 1946, **68**, 1416.—The inter-polymerization of *iso*butene with 2-methyl-2-butene in the presence of an alumina-silica catalyst at 110° C and 500 lb pressure gave a mixture of nonenes which on hydrogenation yielded 29% 2 : 2 : 4-trimethylhexane, 30% 2 : 4 : 4-trimethylhexane, 31% 2 : 2 : 3 : 4-tetramethylpentane, 9% 2 : 3 : 3 : 4-tetramethylpentane and about 1% of unidentified compounds. These nonanes are the same as those produced by the reaction between *tert.*-butyl alcohol and *tert.*-amyl alcohol in the presence of 60% by wt sulphuric acid at temperatures below 80° C. The b.p. d_4^{20}, n_D^{20}, and η^{20} were determined on the four nonanes. G. R. N.

610. Low Temperature Thermal Data on the Five Isomeric Hexanes. D. R. Douslen and H. M. Huffman. *J. Amer. chem. Soc.*, 1946, **68**, 1704.—Thermal studies on the five hexanes have been made over the range 13–300° K employing an adiabatic calorimeter system. Experimental values of the specific heat, heats of transition, heats of fusion, transition temperatures, and triple points were obtained. The entropies at 298·16° K of four of the liquid hexanes were calculated. G. R. N.

611. The System *cyclo*Pentane–Neohexane–Aniline. K. T. Serijan, R. A. Spurr, and L. C. Gibbons. *J. Amer. chem. Soc.*, 1946, **68**, 1763.—The need to purify *cyclo*pentane lead to a study of the ternary system *cyclo*pentane–neohexane–aniline at 15° and 25° C using sp. gr. and refractive index as criteria. G. R. N.

612. *ortho*- and *para*-Diethylbenzenes. J. V. Karabinos, K. T. Serijan, and L. C. Gibbons. *J. Amer. chem. Soc.*, 1946, **68**, 2107.—As part of a project involving the synthesis and purification of 26 aromatic hydrocarbons 6 gal quantities of *o*- and *p*-diethylbenzenes were produced by the condensation of the appropriate ethylphenylmagnesium bromide with diethyl sulphate. The physical properties of the two hydrocarbons were recorded as well as those of the corresponding halides. G. R. N.

613. Solubility of Boron Fluoride in *n*-Pentane. G. N. Cade, R. E. Dunn, and H. J. Hepp. *J. Amer. chem. Soc.*, 1946, **68**, 2454.—The solubility of boron fluoride in *n*-pentane was determined with an average error of about $\pm 5\%$ at 49°, 66°, and 93° C and total absolute pressures ranging from 3·8 to 14·8 atmospheres and was found to be of the order of 1 to 12 cc (S.T.P.) of boron fluoride per gram of *n*-pentane. At constant partial pressure of boron fluoride the solubility is a minimum at about 70° C. G. R. N.

614. Phase Equilibria in Hydrocarbon Systems. H. H. Reamer, B. H. Sage, and W. N. Lacey. *Industr. Engng Chem.*, 1947, **39**, 77.—Five mixtures of the ternary system consisting of methane, *n*-butane, and decane were studied volumetrically at seven temperatures from 100° to 460° F and at pressures up to 10,000 p.s.i. The mixtures were chosen so as to have a fixed molal ration of *n*-butane to decane of about 2 to 1, whereas the mole fraction of methane varied from 0·3785 to 0·9775. The experimental results establish the volumetric properties of these mixtures in the single-phase region at pressures above that of the bubble point and, in the two-phase region, near the bubble-point boundary. A. W.

615. Primary Process in Pyrolysis of Pentenes. E. Gorin, A. G. Oblad, and R. F. Schmuck. *Industr. Engng Chem.*, 1946, **38**, 1187.—The optimum conditions for the production of diolefins by the pyrolysis of various pure pentenes and of pentane–petene mixtures were investigated. Butadiene is the major diolefin from the pyrolysis of 1-pentene and 2-pentene. Small amounts of 1 : 3-pentadiene are simultaneously produced in the pyrolysis of 2-pentene. The largest yields of butadiene are from the pyrolysis of 2-pentene at 750–800° C and at pressures below 0·2 atmosphere. The main side reaction in the pyrolysis of the normal pentenes is cracking to light olefins. Isoprene is the principal diolefin from the pyrolysis of the tertiary pentenes. A small amount of butadiene is simultaneously produced. The best yields of isoprene are obtained by pyrolysis of trimethylene at 800° C. The paraffinic constituents in pentane–pentene mixtures did not contribute appreciably to the production of diolefins in the cracking of these mixtures. The primary reactions in the decomposition of the pentanes were obtained by extrapolation from the experimental results. These are compared with the reactions predicted by the Rice free-radical chain hypothesis. It is shown that the Rice theory must be modified to account for all of the primary reactions observed. A. W.

616. Physics in Hydrocarbon Research. Anon. *Petrol. Times*, 21.12.46, **50**, 1326.—The work done by the Physics Division of the Universal Oil Products Co., and the new laboratories of this company are briefly described. Some notes are given on the research projects which are being carried out: these are ultra-violet spectrophotometry, infra-red, Raman, and emission spectroscopy, mass spectrometry, X-ray diffraction, electron microscopy, and general physico-chemical work. R. B. S.

617. Structures of Ethylene Oxide and Cyclopropane. A. D. Walsh. *Nature*, 1947, **159**, 165.—The instability of ethylene oxide, whose formula is generally given as , is usually explained by the presence of molecular strain; but if this is the case the corresponding propylene oxide would be more stable, which it is not. Polymerization and addition reactions suggest a structure similar to that of ethylene. Evidence is advanced showing that the two electrons of the original λ-bond in ethylene bind the three nuclei C, C, O, in ethylene oxide, giving a structure which may be represented as .

*cyclo*Propane is likewise regarded as having a perturbed ethylenic structure ($H_2C<\begin{matrix}CH_2\\ ||\\ CH_2\end{matrix}$); for (1) substances containing a *cyclo*propane group adjacent to a double bond have absorption spectra characteristic of conjugated compounds, and (2) the dipole moment of *cyclo*propyl chloride is lower than that of *iso*propyl chloride.

H. C. E.

618. Physical Properties of 2- and 3-Methylthiophene. F. S. Fawcett. *J. Amer. chem. Soc.*, 1946, **68**, 1420.—The methylthiophenes were prepared from pentane and sulphur by the Socony Vacuum process. After purification by distillation the following properties were determined: f.p., b.p. over the range 500–900 mm, n_D, d_4, viscosity at 0°, 20°, 25°, and 30° C, specific dispersion at 20° C, f.p. depression for three solutes and some derived constants. G. R. N.

619. The Heat Capacity of Gaseous Naphthenes. R. Spitzer and K. S. Pitzer. *J. Amer. chem. Soc.*, 1946, **68**, 2537.—The heat capacities of gaseous *cyclo*pentane, *cyclo*hexane, and methyl*cyclo*hexane were measured in a Pitzer vaporization apparatus from slightly above the boiling point to about 250° C. A few measurements made at reduced pressures indicated that the heat capacities of the ideal gas are given to good approximation by the Berthelot correction. G. R. N.

620. Alkyl*cyclo*propanes. J. D. Bartleson, R. E. Burk, and H. P. Larkelma. *J. Amer. chem. Soc.*, 1946, **68**, 2513.—1 : 1 : 2-Trimethyl*cyclo*propane was prepared in good yield from 2-methyl-2 : 4-dibromopentane by the Freund reaction at low temperatures. 1 : 2-Dimethyl-3-ethyl*cyclo*propane was prepared in the same fashion from 3-methyl-2 : 4-dibromohexane. In purification of these hydrocarbons by fractional distillation infra-red spectra were employed as criteria. G. R. N.

621. Alkylation of Thiophene by Olefins and Alcohols. W. M. Kutz and B. B. Corson. *J. Amer chem. Soc.*, 1946, **68**, 1477.—Thiophene was alkylated by propene, butene-1, amylene, *cyclo*hexene, *iso*propyl, and *tert.*-butyl alcohols. Several new alkyl thiophenes thereby were prepared. Filtrol X-143 proved to be a satisfactory alkylating catalyst. Phosphoric acid can be used but other typical alkylation catalysts were unsatisfactory, *e.g.*, $AlCl_3$, $FeCl_3$, stannic chloride, hydrogen fluoride, boron trifluoride-dimethyl ether complex, and sulphuric acid. It was not possible to alkylate thiophene with ethylene. G. R. N.

622. Alkylation. J. D. Gibson, R. C. Cole, and M. P. Matuszak. *J. Amer. chem. Soc.*, 1946, **68**, 2728.—A short record of the alkylation of *iso*butane and *iso*pentane with *tert.*-butyl alcohol at room temperature and with *iso*propyl alcohol at 50° C using hydrogen fluoride as catalyst. The main product in each alkylation was of the expected number of carbon atoms per molecule. *tert.*-Butyl alcohol resembled a butene in activity. G. R. N.

623. Isomerization of Alkanes. III. R. C. Wackher and H. Pines. *J. Amer. chem. Soc.*, 1946, **68**, 1642.—A high-vacuum study of the effect of water on $AlCl_3$ and $AlBr_3$ showed that the amount of hydrogen halide produced depends upon the molal ratio of water to aluminium halide used. The effect of this reaction on the catalytic isomerization of *n*-butane was investigated and it was found that the amount of hydrogen chloride formed and the degree of isomerization decrease with the increase of the molal ratio of water to $AlCl_3$ used. In the case of $AlBr_3$ an active catalyst was produced by the action of two moles of water on one mole of the halide. G. R. N.

624. Isomerization of Alkanes. IV. H. Pines and R. C. Wackher. *J. Amer. chem. Soc.*, 1946, **68**, 2518.—Very little exchange reaction and no isomerization occurred when butanes were treated with deuterium bromide–aluminium bromide. In the presence of 0·1 mole-% butenes isomerization occurred and 82–92% of the deuterium was exchanged for hydrogen. Deuteroxyaluminium dibromide acted as a catalyst for butane isomerization; less than 6% of the deuterium underwent an exchange reaction. G. R. N.

625. Vapour Pressures and Saturated Liquid and Vapour Densities of the Isomeric Hexanes. W. B. Kay. *J. Amer. chem. Soc.*, 1946, **68**, 1336.—The critical constants of all the isomeric hexanes and the standard boiling points of all except 2 : 2-dimethylbutane were determined while the values of the liquid density at 20° C were obtained by the interpolation of the density temperature curves. The vapour pressures and saturated liquid and vapour densities were determined from near their atmospheric boiling points to their critical points, employing the static method of vapour–pressure measurement and the pyknometer. Separate empirical equations were derived from the vapour pressure and density data. G. R. N.

626. Effects of Radioactivity on a Naphthenic Acid. I. A. Breger and V. L. Burton. *J. Amer. chem. Soc.*, 1946, **68**, 1639.—Irradiation of a naphthenic acid, *cyclo*hexane carboxylic acid, by alpha particles and deuterons transformed it into *cyclo*hexane and *cyclo*hexene. It was demonstrated that this atomic bombardment did not open the *cyclo*hexane ring. The mechanism of the transformation is as yet undefined. G. R. N.

627. Fischer–Tropsch Syntheses with Ketene. B. R. Warner, M. J. Derrig, and C. W. Montgomery. *J. Amer. chem. Soc.*, 1946, **68**, 1615.—Ketene in the presence of hydrogen reacts on a CO–ThO_2–kieselguhr catalyst to yield hydrocarbons and oxygenated compounds which are similar to the products of the Fischer–Tropsch synthesis. G. R. N.

628. A Precision Capillarimeter. J. J. Jasper and K. D. Herrington. *J. Amer. chem. Soc.*, 1946, **68**, 2142.—After briefly reviewing the errors in the capillary rise method and the measures taken to minimize them, a description is given of a capillarimeter which conforms to the structural and dimensional specifications of a precision instrument offering the advantage of small volume requirement and convenience of manipulation. The instrument was tested with liquids of known purity and surface tension at three temperatures. G. R. N.

629. Preparation of a Raney Nickel Catalyst. A. A. Pavlic and H. Adkins. *J. Amer. chem. Soc.*, 1946, **68**, 1471.—A detailed procedure is given for preparing Raney nickel from nickel aluminium alloy is described. This catalyst is more active than other forms particularly at temperatures below 100° C. G. R. N.

Analysis and Testing.

630. Preparation of Synthetic Samples of Low-Boiling Hydrocarbons. R. H. Busey, G. L. Barthauer, and A. V. Metler. *Industr. Engng Chem. Anal.*, 1946, **18**, 407.—The design and operation of an apparatus for the blending of low-boiling hydrocarbons are described. The apparatus is so designed that standard samples containing any number of components may be prepared in a reasonable time in any size and with a degree of accuracy superior to present methods of analysis. Data are presented for samples in the C_4 and C_5 range. The need for accurate preparation of synthetic mixtures had arisen because of the emphasis placed on newer methods of hydrocarbon analysis, such as infra-red and mass spectroscopy. G. R. N.

631. Specific Dispersion of Hydrocarbons and Petroleum Fractions. M. R. Lipkin and C. C. Martin. *Industr. Engng Chem. Anal.*, 1946, **18**, 433.—An equation is presented for the calculation of specific dispersion of pure hydrocarbons and petroleum fractions from density, refractive index, and approximate mol wt, which may be estimated from mid-boiling point and density or the viscosities at 100° and 210° F. The accuracy of the calculated specific dispersion for petroleum fractions is comparable with the accuracy of measurements obtained on the Abbé instrument $\pm$ 3 units. Tabulated data on grouped pure hydrocarbons and on a variety of petroleum fractions are given. G. R. N.

632. Determination of Alkyl Disulphides. I. M. Kolthoff, D. R. May, P. Morgan, H. A. Laitinen, and A. S. O'Brien. *Industr. Engng Chem. Anal.*, 1946, **18**, 442.—The method described can be used whether mercaptans are present or absent. The di-

sulphides are reduced to mercaptans by means of amalgamated zinc and titrated amperometrically with silver nitrate. If the relative amount of mercaptan present is not large, the disulphide is determined by difference by titrating portions of the solution before and after reduction. To determine a trace of disulphide in a mercaptan the latter is removed as precipitated silver mercaptide before the reduction treatment. G. R. N.

633. Molecular Weight and Mercaptan Content of Mercaptan Mixtures. H. A. Laitinen, A. S. O'Brien, and J. S. Nelson. *Industr. Engng Chem. Anal.*, 1946, **18**, 471.—The mercaptan sulphur content of a mixture of primary mercaptans is determined by titration with silver nitrate and the weight of silver mercaptide formed during the titration is determined. From these data the average mol wt of the mercaptans and the percentage of mercaptans are calculated. The percentage of non-mercaptan material is found by difference. G. R. N.

634. Analysis of Oil Soluble Petroleum Sulphonates. F. Brooks, E. D. Peters, and L. Lykken. *Industr. Engng Chem. Anal.*, 1946, **18**, 544.—A new method is presented in which the sulphonic acids, carboxylic acids, and mineral oil are separated from the inorganic salts by extracting an acidified aqueous suspension of the sample with chloroform. The inorganic salt content is calculated from the sulphated residue obtained from the aqueous phase-making correction for the alkali residue contributed by the sulphonate, carboxylate, and free alkali. A portion of the residue obtained from the chloroform extract is titrated potentiometrically for strong and weak acids to determine the respective equivalents of sulphonic and carboxylic acids present. Another portion of the chloroform-soluble residue is neutralized and the mineral oil isolated by adsorbing the sulphonates and carboxylates on Attapulgus clay. A schematic diagram of the method is given. G. R. N.

635. Vapour–Liquid Equilibrium Still for Miscible Liquids. D. T. C. Gillespie. *Industr. Engng Chem. Anal.*, 1946, **18**, 575.—A new apparatus is described which consists of an electrically heated glass still fitted with a Cottrell pump, a vapour–liquid disengagement chamber, and a condensate trap. Both the boiling liquid and vapour circulate within the apparatus and boiling points may be determined with accuracy as the system ensures complete equilibrium between the two phases. A simple test for the entrainment of liquid in the vapour is described and it is shown that in the new apparatus less than 0·05% entrainment occurs with negligible effect upon equilibrium data. G. R. N.

636. Determination of Basic Nitrogen in Hydrocarbon Feed Stocks. L. Donn and H. Levin. *Industr. Engng Chem. Anal.*, 1946, **18**, 593.—Ammonia is not retained when very dilute gaseous concentrations are bubbled through dilute sulphuric acid. Storage of such dilute gaseous mixtures in iron cylinders results in loss of appreciable basic nitrogen content. Ammonia and amines in concentrations between 0·000015 and 0·008%, calculated as ammonia, have been successfully determined in normal gaseous hydrocarbon feed stocks by a method that involves passage of a cooled (about − 60° C) hydrocarbon sample into a substantially non-aqueous standard solution of sulphuric acid (in acetone), evaporation of the hydrocarbon, and titration of the excess acid with standard alkali. G. R. N.

637. Aids to Computation in Spectrophotometric Analysis of Binary Mixtures. M. Fred and F. W. Porsche. *Industr. Engng Chem. Anal.*, 1946, **18**, 603.—Several methods are described for facilitating the computation of concentrations of binary mixtures from the observed spectrophotometer data. The methods are especially useful for cases of Beer's law failure. One is a graphical method in which the observed optical densities of a mixture determine the location of a point inside a co-ordinate network reading directly in concentrations. The other method utilizes a specially constructed slide-rule on which concentrations are read when the position is adjusted according to the densities. Illustrative data for benzene toluene mixtures. The graphical method can be extended to three component mixtures. G. R. N.

638. Determination of Conjugated Diolefins with Chloromaleic Anhydride. S. T. Putnam, M. L. Moss, and R. T. Hall. *Industr. Engng Chem. Anal.*, 1946, **18**, 628.—A new method of determining conjugated diolefins in hydrocarbon mixtures utilizes chloromaleic anhydride as the dienophilic reagent. The method is based on the quantitative addition of chloromaleic anhydride to conjugated dienes to form an adduct containing a highly reactive chlorine atom which can be determined by the Volhard method after refluxing with aqueous silver nitrate; the vinyl chlorine of the reagent is completely unreactive under the same conditions. G. R. N.

639. Infra-Red Analysis of Hydrocarbon Mixtures. J. H. Lee. *Industr. Engng Chem. Anal.*, 1946, **18**, 659.—Infra-red analysis of gaseous hydrocarbon mixtures involves determination of extinctions from the individual components. Experimental data must be corrected for second-order effects due to energy scattered within the instrument, the structure of the absorption band and intermolecular action. A simple relationship permits correction for these deviations. The equation is $E_{\text{corrected}} = E_{\text{observed}} (1 + aE_{\text{observed}})$. The numerical value of a is determined experimentally for each instrument. The method simplifies the work connected with the calibration or recalibration of a spectrophotometer. Use of a reference substance is suggested as a diluting agent in cases where molecular interaction influences absorption. G. R. N.

640. Conversion of Organic Sulphur to Hydrogen Sulphide for Analysis. E. Field and C. S. Oldach. *Industr. Engng Chem. Anal.*, 1946, **18**, 668.—Organic sulphur compounds are quantitatively converted to hydrogen sulphide by passing with hydrogen over alumina at 900° C. The technique of this operation has made possible the analyses of traces of organic sulphur compounds in gases or liquids when used in conjunction with sufficiently sensitive methods for hydrogen sulphide analysis. G. R. N.

641. Determination of Carbon and Hydrogen. D. D. Tunnicliff, E. D. Peters, L. Lykken, and F. D. Tuemmler. *Industr. Engng Chem. Anal.*, 1946, **18**, 710.—A dual unitized combustion apparatus and improved procedure are described for the determination of carbon and hydrogen in macrosize samples. The dual feature, absence of rubber connections, provisions for adequate combustion control, and well-defined procedure all combine to give accurate results in the minimum of time. Other features are control and indication of all gas-flow rates, adequate and convenient pyrometer temperature indication, addition of extra oxygen between the sample and catalyst, use of carefully determined combustion and operating conditions, and a method for accurate analyses of volatile samples. Using the long precision procedure a skilled operator can make two determinations in an 8-hr day with a precision of $\pm$ 0·008% hydrogen and $\pm$ 0·009% carbon and a probable accuracy of 0·011% hydrogen and 0·015% carbon. Using the short routine procedure an operator can make eight determinations daily with a probable accuracy of 0·05% for each element. Both procedures are applicable in presence of sulphur, halogens, and nitrogen. G. R. N.

642. Quantitative Analysis of Hydrocarbon Mixtures by Means of Raman Spectra. E. J. Rosenbaum, C. C. Martin, and J. L. Lauer. *Industr. Engng Chem. Anal.*, 1946, **18**, 731.—Raman spectra of various aromatic hydrocarbon mixtures and trimethylpentane mixtures were measured with a Steinheil spectrograph. After discussion of the time-consuming photographic method a description is given of a semi-empirical procedure involving a calibration for each system based on a few mixtures of known composition made up from pure compounds. The procedure makes it possible to take into account the mutual interference of close lying Raman lines. G. R. N.

643. Detection of Elementary Sulphur in Gasoline. G. E. Mapstone. *Industr. Engng Chem. Anal.*, 1946, **18**, 498.—The Sommer colour test for free sulphur in pyridine solution has been applied to gasoline by mixing the latter with pyridine then adding caustic soda solution. The presence of elementary sulphur is shown by the blue colour of the intermediate pyridine phase. This test has been compared with the inverted doctor test and is shown to be more sensitive. The mercury test is more sensitive than the Sommer test, but is too sensitive for plant control. G. R. N.

644. Determination of Aromatic Content of Aviation Gasoline. C. M. Gambrill and J. B. Martin. *Industr. Engng Chem. Anal.*, 1946, **18**, 689.—The difference in solubility of picric acid in aromatic and non-aromatic hydrocarbons has been utilized to develop a method for determining the aromatic content of aviation gasoline. The method has been modified to increase its accuracy, precision, and rapidity. The solubility of the picric acid in gasoline is determined at some temperature between 20° and 30° C. Applying a temperature correction to obtain the solubility at 25° C the percentage of aromatics is obtained by reference to a standard curve. The presence of olefins and naphthenes necessitates a slight correction: −1·4% for each 10% of olefin and − 0·6% for each 10% of naphthenes. The method is accurate to ± 1% in the range of 0–25% aromatics. G. R. N.

645. Determination of Olefins in Gasoline. G. R. Bond, Jr. *Industr. Engng Chem. Anal.*, 1946, **18**, 692.—Nitrogen tetroxide reacts with olefins to convert them into oily addition products or nitrosates. Two methods are described which employ this reaction to measure the olefin content of a gasoline. In method A after completion of the reaction at around 70° F the unreacted gasoline is steam distilled from the nitrosates, freed of impurities, and measured. In method B, after completion of the reaction as in method A, the mixture of unreacted gasoline and nitrosates is so treated that a clean separation of the former is obtained and its volume measured. The two methods are under experimental review by Sub-Committee XXV of ASTM Committee D-2. G. R. N.

646. Electronic Detonation Indicator. D. R. de Boisblanc, H. M. Trimble, and L. A. McReynolds. *Oil Gas J.*, 18.1.47, **45** (37), 50.—This paper presents a description of three instruments which have been developed for determining the detonation behaviour of fuels in full scale and laboratory engines. One instrument is designed for full-scale flight uses, and the other two for laboratory use.

The test-meter Model No. 101 employs a magneto-strictive type of pick-up incorporated in a circuit which responds to the detonation waves and quantitatively indicates the maximum rate of change of pressure in each detonating cycle.

The pick-up output voltage is first amplified and then divided into two paths. The first is a low frequency channel, in which the voltages are integrated to yield a low frequency pulse which has the same time variation as the pressure. The voltage is again amplified and clipped to produce a rectangular pulse for each combustion cycle.

The second channel consists of a tuned amplifier which selects high frequency components of the detonation wavelet and rejects the low frequency wave due to the normal combustion pressure variation. The output of this amplifier passes through a mixer or switch which is made operative during the combustion-cycle interval by the rectangular pulse output of the low-frequency channel. The output voltage of the mixer is converted into an exponential pulse which is modified by a second pulse generator to give a sustained pulse whose height is proportional to the peak amplitude of the detonation wavelet. The duration of this pulse is sufficiently great to permit the high-speed internally damped meter to rise to the peak value.

The two instruments for laboratory use Model 102A and the Steady reading meter are much simpler in design. The first has already been described in Abstract No. 288 (1947), and the second is modified to include a multivibrator and integrator which have the effect of giving steady readings of average knock intensity. J. N.

647. Determination of Hydrogen Sulphide in Gases. E. Field and C. S. Oldach. *Industr. Engng Chem. Anal.*, 1946, **18**, 665.—Two colorimetric methods were developed for the analysis of traces of hydrogen sulphide in gases. The hydrogen sulphide is first absorbed in a caustic solution and in the more sensitive method is converted to bismuth sulphide. The concentration of the resulting suspension is determined by means of a spectrophotometer. In the absence of this instrument the sulphide is reacted with a uranyl cadmium reagent and analysed by visual comparison in a chromometer. With the spectrophotometric method as little as 7 micrograms of hydrogen sulphide may be determined with a precision of ± 10%. For larger samples the precision improves to ± 3%. The chromometer technique requires five times as much sulphide for equal precision but still is far more sensitive than titration. G. R. N.

648. Identification of Sulphur Compounds in Gas Mixtures. C. S. Oldach and E. Field. *Industr. Engng Chem. Anal.*, 1946, **18**, 669.—A sensitive method for identification and quantitative determination of sulphur compounds present in gas mixtures depends on differences in solubility of the sulphur compounds in an inert solvent. A complete analysis usually involves both an absorption and a stripping run in a multiple-plate saturator. The total sulphur content of the gas leaving the saturator is plotted against gas volume. A stepwise curve results, wherein the gas volume at which the sulphur concentration changes abruptly is characteristic of a specific sulphur compound and the magnitude of the change is a measure of the concentration of that compound. Identification runs on manufactured gas and coke-oven gas are presented. G. R. N.

649. Automatic Determination of Aniline Point. C. W. Brown. *Industr. Engng Chem. Anal.*, 1946, **18**, 739.—An apparatus is described for the automatic determination of aniline point of petroleum products. The basic principle involved comprises the use of the electric eye as a substitute for visual observation. The test sample is internally heated or cooled, the temperature is maintained uniform by stirring and temperature equilibrium is automatically accomplished by a relay system. The latter is activated by directing a light beam through the sample on a photocell, the light beam being interrupted periodically as the sample clears or clouds with slight temperature change. G. R. N.

650. Determination of *pp'*-D.D.T. in Dusts and Oils. J. B. LaClair. *Industr. Engng Chem. Anal.*, 1946, **18**, 763.—A method is described for the determination of *pp'*-D.D.T. in commercial dusts and oil solutions. It is based on the dehydro chlorination of the sample at 25° ± 0·1° C, in 95% ethyl alcohol solution for dust mixtures and in kerosine solution for oil blends, for 15 minutes using 20 ml of *N*-ethanolic sodium hydroxide. Comparative results are given for the crystallization method. G. R. N.

651. Proportional Flow Controllers for Liquids. W. R. Wilkinson and H. A. Beatty. *Industr. Engng Chem. Anal.*, 1946, **18**, 725.—An apparatus is described to effect the accurate control of reflux ratio with variable throughput in fractional distillation. It operates on the principle of directing a downflow of liquid into a uniform free-falling sheet or curtain which is split into two parts by a movable divider. G. R. N.

652. Adsorption Apparatus. C. B. Wendell, Jr. *Industr. Engng Chem. Anal.*, 1946, **18**, 454.—A high vacuum apparatus without stopcocks is described which permits efficient handling of hydrocarbon gases in adsorption work. Positive control of the gases has been achieved through "mercury stopcocks" which involve simply hypodermic syringes and ground-glass valves. G. R. N.

653. Evaluation of Laboratory Distillation Apparatus. F. C. Collins and Y. Lantz. *Industr. Engng Chem. Anal.*, 1946, **18**, 673.—Test methods have been developed for evaluating laboratory distillation apparatus under conditions approximating actual operation, rather than under ideal conditions for maximum separation. In particular, the effect of reflux ratio on efficiency and separation has been studied. Test methods for evaluating the other principal characteristics of distillation apparatus are also described in detail. The Oldershaw glass-bubble plate column has been improved and studied using these test methods. The column was very satisfactory for analytical distillations of hydrocarbon mixtures because of uniformity of its operating characteristics. Automatic stillheads and other accessory equipment have been developed which contribute to the unformity of the column performance. G. R. N.

654. Product Withdrawal from Distillation Columns. D. M. Oldroyd and L. A. Goldblatt. *Industr Engng Chem. Anal.*, 1946, **18**, 761.—It has generally been assumed that the best way to operate high efficiency distillation columns is with as nearly a continuous product withdrawal rate as possible. The relative effectiveness of intermittent versus continuous withdrawal was tested with a heligrid-packed, a helices-packed, and a gauze plate column. Especially with the heligrid-packed column distinctly better separation was obtained by product withdrawal once every hour than once every 30 sec. G. R. N.

655. Fractionating Column. E. A. Naragon and C. J. Lewis. *Industr. Engng Chem. Anal.*, 1946, **18**, 448.—An improved small glass centre tube fractionating column which can be easily reproduced is described and construction details are given. The fractionating section, which is surrounded by a silvered vacuum jacket, is 30·5 cm long and consists of an 8 mm inside diameter outer tube and a 6·5 mm outside diameter centre tube. Above this section a distributor is used which distributes the reflux from the head half to the outer tube and half to the centre tube. The column is equipped with an automatic take-off valve. It has an efficiency of over 75 theoretical plates with an H.E.T.P. of less than 0·4 cm. G. R. N.

656. New Head for Laboratory Fractionating Column. J. D. Bartleson, A. L. Conrad, and P. S. Fay. *Industr. Engng Chem. Anal.*, 1946, **18**, 724.—This take-off head is a totally condensing head to give the advantages of high throughput and low hold up. The feature of it is a steel ball bearing encased in glass. This assembly is seated by a joint ground into the throat of a glass funnel leading to the receiver. For alternate use with the head a double-type condenser utilizing dry ice cooling in addition to the conventional type is described. This condenser gives efficient and complete condensation of C_4 fractions. It avoids the troublesome change from dry ice to liquid coolant and eliminates the need for expensive cooling systems. G. R. N.

657. Rapid Analysis of Fischer Synthesis Catalyst. C. H. Hale. *Refiner*, 1946, **25**, 265.—Rapid methods for the determination of cobalt and thorium in Fischer kieselguhr catalysts are described. Cobalt is determined by titrating with ferricyanide to a "dead-stop" end-point, while thorium is precipitated as the iodate and determined volumetrically. Details of the methods and results obtained with actual and synthetic catalysts are given. G. R. N.

658. Analysis of Furfural Water Solutions. J. Griswold, M. E. Klecka, and R. V. O. West. *Industr. Engng Chem. Anal.*, 1946, **18**, 696.—Dependable analyses of furfural-water solutions are needed in connection with furfural solvent refining and extractive distillation processes. Two accurate methods are described, the first being a cloud point method for the determination of water in furfural, and the second being electrometric titration with bromine to determine furfural in water. G. R. N.

Gas.

659. Natural Gas. Steady Expansion to Continue in 1947. D. M. Duff. *Oil Gas J.*, 25.1.47, **45** (38), 169.—Revenues, sales, customers, and production of the natural gas industry showed gains in 1946, but expansion was hampered by lack of materials. Completion of new lines would increase supply nearly 20% of total 1945 sales.

By using adapted Fischer–Tropsch process 15 thousand million brl would be added to oil reserves in U.S.

Two charts give Gas Sales and Revenue. G. A. C.

Gas and Fuel Oils.

660. Fuel-Oil Properties. W. L. Nelson. *Oil Gas J.*, 18.1.47, **45** (37), 89.—No. 127 in the *Refiners' Notebook* series relates the properties of the various fuel oils to their uses.

For example, flash points of over 100° F are required for safety, and below 230° F for ease of ignition of oils used in vaporizing-type burners. A table relating viscosity and burner oil temperatures is given, also one showing heating value of fuels.

G. A. C.

661. Liquid Fuel for High Temperature Processes. T. C. Bailey, F. J. Battershill, and R. J. Bressey. *Petrol. Times*, 7.12.46, **50**, 1284.—The specific gravity, flash point, calorific value, and viscosity characteristics of the three fuel oil grades at present available are first discussed. The advantages of liquid fuels which are then discussed are: (1) uniformity of quality, (2) cleanliness, (3) ease of storage, (4) saving of labour, (5) control ability and flexibility, (6) facility of handling, (7) absence of ash, (8) high flame temperatures, (9) luminous flames, (10) high furnace efficiencies, and (11) greater

outputs from furnaces. Some notes are then given on the use of oil-fuel for the following industrial applications: (1) open-hearth furnaces, (2) oil as an auxiliary to steel-works gases, (3) rotary melting furnaces, and (4) rotary calcining furnaces.

R. B. S.

662. Coal-Tar Fuel 200 was 40% of Wartime Industrial Consumption. E. B. Davies. *Petrol. Times*, 21.12.46, **50**, 1318.—The name "Coal-Tar Fuel 200" (which is often abbreviated to "CTF 200") signifies that the fuel must be heated to 200° F before it can be properly atomized: this fuel has also been called "Creosote Pitch Mixture" and "50/50 Mixture."

The specifications and the physical and chemical properties of CTF 200 are described. The use of any viscous fuel requires the reduction of viscosity by heating, and the maintenance of the necessary temperature up to the point of atomizing. So that this shall be properly accomplished it is imperative that (1) local overheating be avoided, (2) pipe blockage be prevented, (3) flow control be adequate, (4) installation of burners and controls be correct, and (5) corrosion be reduced to a minimum. Each of these points is discussed insofar as the application of CTF 200 is concerned. R. B. S.

Lubricants.

663. Physical Chemistry of Lubricating Oils. A. Bondi. *Refiner*, 1946, **25**, 259.—The first of a series of three articles on the assembly of scattered data on the physical properties and physicochemical behaviour of lubricating oils. In this article the following topics appear: P.V.T. data, density and molar volume, coefficient of expansion and temperature coefficient of density, compressibility, surface tension, interfacial tension, and emulsification and foaming. G. R. N.

664. The Effect of an Electric Field on the Viscosity of Liquids. E. N. De C. Andrade and C. Dodd. *Proc. roy. Soc., Series A*, 5.11.46, **187**, 296.—The effect of an electric field on the viscosities of a range of non-polar and polar liquids has been investigated and it has been confirmed that with non-polar liquids the influence of an electric field transverse to the flow shows no viscosity effect. The non-polar liquids examined were transformer oil, carbon disulphide, carbon tetrachloride, and benzene—all of which when dry were found to be very poor conductors by comparison with polar liquids. When saturated with water, these compounds became conducting to a degree comparable with polar substances but showed no viscosity change with applied electric field.

A range of polar liquids examined included dimethylamine, ethylene dichloride, methyl, ethyl, propyl, and amyl acetates, all showed good conduction together with a large increase in apparent viscosity, the limiting viscosity increase being proportional to the conductivity at high fields. Other polar compounds, such as acetone and acetonitrite, showed decreasing conductivity with increase in the degree of purification indicating that a specimen so pure as to be non-conducting would probably show no change in apparent viscosity with electric field. Polar liquids which gave no viscosity or conductivity include toluene, metaxylene, and methyl phenyl ether.

It is concluded, therefore, that for marked viscosity effect the presence of both conduction which implies ionization and polar molecules are essential. Without the former there is no local concentration of ions, while in the absence of polar molecules clustering of the latter are prevented, since the ions act as centres around which the polar molecules segregate.

Substitution of an alternating for a direct field does not produce viscosity variations.

An apparatus for measuring the apparent viscosity is described, this is based on employing plane metal boundaries between which the liquid passes, the metal boundaries serving as electrodes.

When the electric field is applied parallel to the lines of flow no viscosity effect was observed. H. C. T.

665. Failure of Plain Bearings. B. C. Kroon. *Ingenieur*, 1947, **59**, 1.—Starting from the generally accepted view that failure of plain bearings is caused by insufficient cooling, an attempt is made to formulate an equation relating the heat load of a bearing and the cooling capacity of the lubricant. The heat load of the bearing is expressed in

terms of the coefficient of friction, the bearing dimensions, the average pressure, and the speed of revolution. The cooling capacity of the lubricant is calculated as a function of oil flow, dependent on bearing design, viscosity characteristics of the oil and pressure drop. Calculations of the bearing pressure for 2- and 4-stroke engines are represented in the form of polar diagrams showing the load at any position during the rotation of the crankshaft. Sudden changes in load occur, resulting in a small displacement of the shaft in the bearing. The effect of this displacement is to create locally sub-normal pressures in the oil film. Upon restoring the pressure to normal, "implosion" phenomena occur, causing cavitation of the bearing surface. In the course of time this cavitation may lead to the complete disintegration of the bearing metal. M. B.

666. Secrets of German Lubricating Oil Technology Revealed. Part VI.—Finished Lubricating Oils—Storage and Distribution. C. I. Kelly. *Petrol. Times*, 9.11.46, **50**, 1156.—The Germans' war-time organization responsible for the storage, distribution, blending, and packaging of lubricants is briefly reviewed.

This instalment concludes the present series, the others of which were published in the issues of the *Petroleum Times* of March 2, 16, and 30, April 13, May 11, June 8 and 22, July 20, and August 17 and 31: see Abstracts Nos. 629, 690, 691, 698, 814, 984, 895, 1136, and 1136A (1946), and 278 (1947). R. B. S.

Bitumen, Asphalt and Tar.

667. Asphalt Road Work. E. R. Knight. *Rds and Rd Constr.*, 1947, **25**, 3.—This article deals with progress in the use of asphalt macadam for road surfacing. Clinker asphalt has been used both as a thin carpet of topping directly on a base and as a carpet superimposed on clinker asphalt base courses (or "binder" coats) of various thicknesses. Surfacing coats from 1 to 2 in thick over worn wood-block paving and over waterbound macadam roads have proved generally satisfactory, providing no interference by trench excavation, etc., occurred. Experiments are described in which cubical granite was spread over the surface of the asphalt after raking, but before consolidation, to obtain a mosaic surface and increase the surface resistance to skidding; complete success was obtained with granite from 1½ in upwards. Differentiation in colour (*e.g.*, to mark pedestrian crossings) was obtained by using stone of distinctive colour. During the war defective areas of wood-paving blocks were replaced with asphalt up to 6 in in thickness, and even thicker in cases where it was necessary to avoid delays, either in concreting or in adjustment of adjoining foundation levels. G. P. K.

668. Concrete Flooring with Asphalt Admixture. F. O. Anderegg. *A.S.T.M. Bull.*, Dec. 1946, **143**, 11.—Work is described on the development of flooring material containing Portland cement, asphalt and aggregate: material of this type produces floors which resist indentation much better than asphalt floors, but at the same time reduce markedly the spine-jarring impact found with cement concrete floors. In this type of system the asphalt is the discontinuous phase. Experimental mixes were made containing from 5 to 12½% of cement and from 0 to 5% of asphalt emulsion, and it was found that floors of satisfactory strength were obtained in the range of 7½ to 12½% of cement and with 2 to 3% emulsion. Details of methods used in laying floors and results obtained on testing samples for compressive and flexural strength are given. A recommended mixture which has given excellent results requires 3½ bags of cement and 7 gal of asphalt emulsion per cu. yd of concrete, the ratio of sand to stone being determined by the necessity of maintaining workability. A discussion follows the article. G. P. K.

669. Cotton Fabric in Bituminous Construction. P. F. Critz. *Public Roads*, Oct.–Dec. 1946, **24** (10), 251.—An investigation in the U.S.A. of the use of cotton fabric in bituminous highway construction and maintenance is described.

Laboratory tests showed that the material, when impregnated with bitumen or tar, might have some value in forming a waterproof membrane to prevent surface moisture reaching the base, but in practice this was not so. The fabric deteriorated even when surface and base failures did not occur, thus cotton fabric would not compensate for

inadequate base support or allow for construction of cheaper bases. The fabric was found beneficial under certain conditions when used on wooden floors.

The cost of construction, when using cotton fabric, was materially increased, with little or no practical value. On bridge floors the increased cost may be warranted if the condition of the structure is taken into account. G. A. C.

Special Hydrocarbon Products.

670. Napalm. L. F. Fieser, G. C. Harris, E. B. Herhsberg, M. Morgana, F. C. Novello, and S. T. Putnam. *Industr. Engng Chem.*, 1946, **38**, 768.—The thickening agent employed by the Chemical Warfare Service, U.S. Army, for the preparation of gelled gasoline fuels used as filling for incendiary bombs and in flame-throwers, was an aluminium soap derived from a combination of acids of the types exemplified by lauric acid and by naphthenic or oleic acid. A description is given of early work on the problem. A. W.

Derived Chemical Products.

671. Copolymers of Dimethylstyrene Vinyl Fatty Esters with Butadiene. P. O. Powers. *Industr. Engng Chem.*, 1946, **38**, 837.—A series of synthetic rubbers made by emulsion polymerization of butadiene and *a*, *p*-dimethylstyrene in various ratios have been prepared. These rubbers are comparable to copolymers with styrene but are apparently superior in tensile strength, and more nearly resemble natural rubber in processing characteristics. Synthetic rubbers have also been prepared from butadiene and vinyl esters of fatty acids from vegetable oils. These synthetics are somewhat softer than GR-S. Tricopolymers of butadiene, vinyl fatty acid esters, and a monovinyl compound exhibit interesting properties, notably improved resistance to cut growth. A. W.

672. Preparation of Technical D.D.T. H. S. Mosher, M. R. Cannon, E. A. Conroy, R. E. Strien, and D. P. Spalding. *Industr. Engng Chem.*, 1946, **38**, 916.—A study has been made of the effect of time, temperature, acid strength and excess chlorobenzene on the condensation of chloral and chlorobenzene in the presence of sulphuric acid to give D.D.T. When 98–99% sulphuric acid is used with 4 moles of chlorobenzene per mole of chloral and at a temperature of approximately 15° C for 5 hrs, 95–98% yields of D.D.T. can be obtained. A. W.

Miscellaneous Products.

673. Secrets of German Fuel Technology Unearthed. Anon. *Petrol. Times*, 7.12.46, **50**, 1270.—The following C.I.O.S., B.I.O.S., and F.I.A.T. Reports and Final Reports are briefly reviewed.

C.I.O.S. XXXII–17. "Underground Factories in Central Germany" (154 pp.).

B.I.O.S. Report No. 572. "Investigation into the Manufacture and Use of Carbon-Blacks and Lamp-Blacks in Germany" (119 pp.), H.M.S.O., 10*s*. 6*d*. (post 2*d*.).

B.I.O.S. Final Report No. 586. "Ernst Schliemann's Oelwerke und Export-Cerecin-Fabrik, Hamburg, Germany. Lubricants and Miscellaneous Products" (32 pp.).

B.I.O.S. Final Report No. 597. "Interrogation of Dr. C. H. N. Bensmann, October 10, 1945" (3 pp.).

B.I.O.S. Final Report No. 598. "Oelwerke Julius Schindler G.m.b.H., Hamburg, Germany" (15 pp.), H.M.S.O., 1*s*. 6*d*. (post 2*d*.).

B.I.O.S. Final Report No. 635. "Mineralolwerke Albrecht, Lubricants" (32 pp.), H.M.S.O., 2*s*. 6*d*. (post 2*d*.).

B.I.O.S. Final Report No. 636. "Mineralolwerke F. Harmsen, Kiel, Germany. Lubricants" (11 pp.), H.M.S.O., 1*s*. 6*d*. (post 1*d*.).

B.I.O.S. Final Report No. 637. "Olex Deutsche Benzin und Petroleum Gesellschaft. Fuels and Distribution" (13 pp.), H.M.S.O., 1*s*. 6*d*. (post 1*d*.).

B.I.O.S. Final Report No. 638. "Deutsche Erdol A.G., Hamburg, Germany. Crude Oil and Products" (12 pp.), H.M.S.O., 1*s*. 6*d*. (post 1*d*.).

B.I.O.S. Final Report No. 639. "Deurag-Nerag Gewerkeschaft Deutsche Erdol Raffinerie und Neue Erdol Raffinerie, Fuels and Lubricants" (30 pp.), H.M.S.O., 3*s*. (post 2*d*.).

B.I.O.S. Final Report No. 697. "Fire Protection of Oil Installations in Germany" (44 pp.); H.M.S.O., 4*s*. (post 2*d*.).

B.I.O.S. Final Report No. 704. "Mechanical Foam Liquid and Equipment" (13 pp.).

B.I.O.S. Final Report No. 748. "Manufacture of Fatty Acids by Oxidation of Paraffins: Hydrogenation of the Fatty Acids at I.G. Ludwigshafen-Oppau" (15 pp.), H.M.S.O., 2*s*. (post 1*d*.). Divided into three sections, viz.:

I. Manufacture of Fatty Acids;
II. Hydrogenation of Fatty Acids, Oppau;
III. Hydrogenation of Soap Acids, Ludwigshafen.

F.I.A.T. Report No. 698. "Photographing a Single-Fuel Injection" (2 pp.).

F.I.A.T. Report No. 709. "Verbreunungsmoteren: Thermodynamische und Versuchamässige Grundlagen under Besonderer Berucksichtigung der Flugmoteren" (345 pp.). A photo-lithographic reproduction of Professor Dr. Ing. habil Fritz A. F. Schmidt's book on I.C. Engines. Divided into several sections, viz.:

Part AI. General Motor Problems.
I. Thermodynamics of Idealized Engine Cycles.
II. Actual Cycle Processes.
III. Essential Factors for Efficient Motor Operation.
Part AII. Motor Supercharging.
Part B. Special Problems of Aircraft Engines.
I. Non Supercharged Motors.
II. Supercharge Systems driven by Motor.
III. Exhaust Driven Turbo-superchargers.
IV. Suitability of Different Motor Systems.

There are also extensive supplements giving examples of numerical calculations and a treatise on thermodynamic functions, a report on the results of researches between 1940 and 1945 (mainly on ignition), and a literature and subject index.

F.I.A.T. Final Report No. 741. "Catalysts for Coal Hydrogenation" (3 pp.), H.M.S.O., 1*s*. (post 1*d*.).

F.I.A.T. Final Report No. 810. "Activated Clay. Bleaking Adsorbents."

R. B. S.

Engines and Automotive Equipment.

674. The De Havilland Ghost. Anon. *Aeroplane*, 7.2.47. **72**, 158.—For the first time the details are released of this engine and a cutaway drawing presents the leading features of the design.

Leading particulars are: Dimensions: Max. diameter 53 in (1·3 mm); overall length 115·5 in (2·9 mm) (to rear flange of standard exhaust cone); Weight: Dry, bare, 1910 lb (865 kg); normal dry, 2011 lb (910 kg), without aircraft accessories; gross dry weight, 2073 lb (940 kg); in running order, 2096 lb (950 kg); Performance: Take-off and combat 5000 lb S.T. (2270 kg) at 10,000 r.p.m. and 1·06 lb/lb thrust/hr specific consumption; maximum climbing, 9500 r.p.m.; maximum cruising, 8500 r.p.m.; idling, 3000 r.p.m.

I. G. B.

675. Vogue of the C.I. Engine and the Future of Fuels and Lubricants. E. S. Shrapnel-Smith. *Petrol. Times*, 23.11.46, **50**, 1218.—The use of the compression ignition engines for commercial road transport and the sources of fuels and lubricants are very briefly discussed. The operational merits of the C.I. engine include high performance measured in ton-miles per gallon of fuel, good power per stroke at starting and at low r.p.m., and absence of carbon monoxide in the exhaust gases.

R. B. S.

MISCELLANEOUS.

676. United Kingdom Petroleum Import and Export Trade. Anon. *Petrol. Times*, 9.11.46, **50**, 1160.—Statistical data on imports and exports of crude oil and refined products for September and the first three quarters of 1946 are presented, together with comparative figures for 1945 and 1938. R. B. S.

677. United Kingdom Petroleum Import and Export Trade. Anon. *Petrol. Times*, 7.12.46, **50**, 1274.—Statistical data are presented on imports and exports of crude oil and refined products (including oil fuel bunkering of shipping) for October and the first ten months of 1946: comparative figures for 1945 and 1938 are also given. R. B. S.

678. Decline in Roumanian Oil Production. E. C. Masterson. *Petrol. Times*, 7.12.46, **50**, 1260.—The decline in Roumanian production is discussed: the author concludes this is chiefly due to the lack of any systematic exploration programme rather than to the complete exhaustion of Roumanian reserves. R. B. S.

679. Refinery Yield Patterns Determined by Shifting Demand Cycle. R. B. Tuttle. *Oil Gas J.*, 25.1.47, **45** (38), 146.—A review of refining yields over a number of years at U.S. refineries is given. Gasoline demands decreased, but there were substantial increases in yields of burning oils and distillates.

Catalytic cracking and reforming methods allow for flexibility of operation and economic production of intermediate oils, and there is a trend towards greater production of intermediate oils. Flexibility of the modern processes enables the operator to meet local market conditions.

Charts show yields of products and crude runs to stills, together with yields % of crude runs, over a number of years in U.S. Refineries. G. A. C.

680. Some Novel British Patents on Fuel and Power. C. Ridley. *Petrol. Times*, 21.12.46, **50**, 1337.—Six recent British patents are briefly discussed: they are Nos. 574, 535; 573, 190; 574, 119; 574, 667; 574, 608; and 576, 777; dealing, respectively, with improved lubricating pads, burning gaseous fuel under water, selective lubrication of gears, continuous centrifugal sludge separation, a self-lubricating valve, and pipeline repairs. R. B. S.

BOOK REVIEWS.

Petroleum Engineering (Oilfield Development). L. C. Uren. 3rd Edition (1946). New York and London: McGraw-Hill, 1946. Pp. xiii + 764. $6.50.

Professor Lester Charles Uren, of the University of California School of Petroleum Engineering, in this work brings up to date one section of his well-known treatise on petroleum engineering.

His object, as stated in the Preface, has been to provide a text or work of primary reference for petroleum engineering students in that part of their curriculum which pertains to the technology of oilfield development.

The opening chapters are devoted to the properties and occurrence of petroleum in nature, petroleum exploration methods, and the principles to be observed in planning the development of an oilfield.

A major portion of the book deals with drilling methods and equipment, and with oil well completion practices.

The final chapters concern the keeping of drilling records, well logs, data on cores and samples; also the records of electrical logging, deviation, and temperature surveys, etc. These subjects, as compared with the second edition published ten years ago, have been considerably expanded, and in particular demonstrate how necessary it is to re-edit such a primary reference work at frequent intervals in order to keep pace with modern development and invention.

The author has succeeded in presenting a work which deals clearly and adequately with almost every phase of the subject, without it being unmanageable in size. At the end of each chapter is a selected bibliography which will be of great value to those wishing to pursue a particular branch in detail. E. C. S.

Essentials of Petroleum. Dr. P. H. Frankel. London: Chapman and Hall, 1946. Pp. 173. 15*s*.

The sub-title of "Essentials of Petroleum" is "A Key to Oil Economics," and in this book an attempt is made to determine the underlying economic factors on which the petroleum industry is based.

The book is divided into four sections: Part I dealing with oil and public opinion, Part II with the economics of liquid, Part III with price structure, Part IV the shape of the industry, and Part V with policies for the Industry.

Dr. Frankel analyses a series of other industries, textile, coal, steel, and rubber, in so far as the relation between variable and fixed costs are concerned. He quotes figures to show the high capital investment per worker in the petroleum industry where the labour cost is only 10–15% of the total cost, and refinery workers are amongst the most highly paid of any employees. The large capital investment in unit plants leads to the economic necessity of maintaining throughputs as high as possible, and in consequence to price reduction. Dr. Frankel states that the technical factors involved inevitably lead to intense competition and to the necessity of regulating the market.

In Part II, dealing with the economics of liquid, a statement is given in italics "It is perhaps an appropriate speculation that the particular value of liquid hydrocarbons derives from their being easily gasified." Nevertheless, some of the more important problems in connection with the utilization of petroleum products as fuel are due to the fact that they are not always easily gasified. This applies to gasoline, kerosine, diesel fuel, and fuel oil. The essential difference between petroleum and solid fuels lies in their higher calorific value and the liquid character of the former.

In Part IV, some details are given of the rise of various groups in petroleum, and the whole book is writen in a conversational style, and at the end of each chapter references are given to a wide range of publications. The book is well produced, although it has the appearance of being subdivided into too many sections. A Bibliography is provided, together with a good index.

Dr. Frankel points out that the transport of petroleum has always presented problems peculiar to the petroleum industry, in that large-scale transportation of a

liquid involves the establishment of pipe-lines, tankers, and tank installations, which by and large can only be used for petroleum products.

In the final section on policies for the industry, the influence of national policy on the petroleum industry is discussed, and the position of " majors " and " minors " in the petroleum industry. He states the justification for the majors lies in their being so big that they cannot help being leaders in the true sense of the word. Whilst Dr. Frankel considers that, in the international field, governments are fulfilling the function of organizing the petroleum industry, he feels that such a procedure can only be successful if it leaves intact industrial enterprises of the industry's component parts. F. H. G.

Hydrofluoric Acid Alkylation. Bartlesville, Okla.: Phillips Petroleum Co., 1946. Pp. vi + 366 + Index. $7.50.

Fluorine is a relative newcomer to the list of elements which, either in themselves or in the form of their compounds, are used in industry to a major extent. The lead in the development of hitherto relatively rare fluorine compounds for industrial application was given by the introduction, some ten to fifteen years ago, of the " Freon " compounds, first as refrigerants and subsequently for wider applications. Since then the field of industrial fluorine chemistry has widened rapidly and the use of hydrofluoric acid as an alkylation catalyst is one of the newer developments.

This publication may be said to fall into an intermediate class between a scientific monograph and a plant operation manual. It is compiled from a series of reports, made to the petroleum industry, dealing with operating technique, maintenance problems, and general data regarding the first HF alkylation plants that were built. The book is written primarily from the practical aspect—that is, from the point of view of the plant operator—the amount of theoretical information and basic principles that is given regarding the HF alkylation process is reduced to the bare minimum of a few introductory pages. Whilst it is not suggested that further information of this type should necessarily be included in a manual of this nature it would not have been amiss to have given references to the many original papers that have appeared on the subject of HF alkylation, so that those who seek additional information on the theoretical and funamental aspects would have found a bibliography within the covers of this comprehensive guide to the practical angle.

After the brief introduction, mentioned above, dealing with the chemistry of HF alkylation, the general principles of the design of units for carrying out this process are discussed in an adequate manner. Both schematic and detailed flow diagrams are given and individual mention is made of many of the details of certain of the special features concerned with the use of hydrofluoric acid, which is a novel substance from the chemical-engineering standpoint, requiring particular attention to be devoted to constructional materials.

The next sections, which are the core of the book, deal with the operation of HF alkylation units; the effect of different variables and of changes of feed stock on the operation of the plants is discussed with considerable thoroughness. In addition to details of the operation of full-scale units, results and experimental procedure for pilot plant tests are also given.

A chapter on analytical methods deals very fully with the special laboratory procedures, involving tests on the catalyst and the determination of fluorine compounds in plant products, which are required in connection with the control of HF alkylation plants. The test methods are fully described and, in cases where special equipment is recommended, full details of this are given, together with reference to the original sources where applicable. The appendix includes a schedule showing the plant control tests necessary and the intervals at which they should be performed.

As might be expected in an American publication, considerable stress is laid on safety precautions, and the procedures which have been shown by experience to be necessary in working with such a potentially hazardous material as hydrofluoric acid are outlined in full. The safety clothing recommended is both described and illustrated and the first-aid treatment of burns from HF, should these occur despite the safety precautions, is prescribed, together with some suggestions for the medical treatment of HF poisoning. In this connection there has evidently been a slight error in the arrangement of the sections inasmuch as a paragraph on the treatment of HF burns is included in the chapter dealing with the properties of HF, whereas it

should obviously have been placed in the previous chapter where other first-aid treatments are given.

The chapter dealing with the fundamental data on HF is compiled both from published sources (to which references are given) and also includes material obtained by the Phillips laboratories in their work with this substance, and its mixtures with the lower hydrocarbons.

Information on plant troubles, and corrosion observations, are given both in the text and also in a comprehensive appendix which incorporates the essential information from shut-down inspection reports on a number of commercial HF alkylation plants.

It is of interest to note that in the production of vessels for such plants very modern techniques, including the radiographic examination of the parts to detect welding flaws, have been employed.

The publication of a manual such as the one under review can be used as an argument in favour of the present patent system, which both here and in the U.S.A. has lately come under a considerable fire of criticism. If it were not for the protection afforded by patents, it would not be practicable for a large organization to make public in this way the very considerable body of information, both technical and operating, which is contained in this publication. In fact the publication of work of this type is an answer to those who decry the present patent system, since, if there were no patent protection those who had, at a very considerable cost, developed processes such as these would obviously not be willing to share them with the world at large, and by keeping them secret would deprive industry as a whole of valuable fundamental data and "know-how," the free propagation of which is essential to the advance of science generally.

The style in which the book is written is concise and laconic, such a rendering being eminently suitable for imparting information of this type. The printing has been carried out by a photo-reproduction process, the resulting effect, whilst clear, cannot be said to be very pleasing to the eye.

The book can undoubtedly be considered as essential to all who are operating HF alkylation units or who are proposing to carry out any type of work involving the use of hydrofluoric acid as a catalyst in a petroleum processing method. V. B.

Chemicals from Methane. J. P. Lawrie, Ph.D. London: Science Services, Ltd., 1947. Pp. 21. 3*s.* 0*d.*

Seven years ago a larger book was published in London by Dr. Lawrie, reviewing the natural sources, production, nature, and uses of methane. The present booklet is much less pretentious. In the preface the author states that the purpose is "to give a rapid survey of the current methods of utilizing a gas of which very considerable supplies exist in this country." He wants to see every possible home manufacture developed, and he cites carbon-black as a material which "could and should" be manufactured in the United Kingdom, and particularly in Scotland, instead of importing it.

Dr. Lawrie outlines the processes in use in other countries for the production of chemicals from methane. He claims that the opportunity for similar industries based on methane exists in this country. He states that coal and coal-gas offer unlimited supplies of methane, but he does not recommend the use of any existing fuel in short supply, as sources of methane, whilst methane exists in the country in the form of natural gas.

He outlines briefly the processes used abroad for the production from methane of the following chemicals: carbon-black; hydrogen for use in the synthesis of ammonia; acetylene; chlorinated hydrocarbons like chloroform; nitromethane; methanol; formaldehyde; formic acid; and hydrogen sulphide. All of these, he says, serve to show that in other countries methane is well exploited on the commercial scale.

No attempt is made to compare the enormous quantity of natural gas available in the big oil and natural gas-producing countries, like the United States, with the comparatively small quantity known to be available in Great Britain.

The author does not disguise his indignation that it was necessary to import carbon-black during the war years. He claims that it should have been manufactured from the natural gas existing in the United Kingdom.

On page 5 he states that "the utilization of natural gas constitutes a challenge to applied science and the economy of the nation—particularly Scotland—which possesses vast supplies of methane, the use of which would materially assist her industries and provide steady employment for a large number of skilled men and technicians."

On page 6 he again refers to the considerable amount of natural gas in Scotland where, he says, one such source is stated to supply 12 million cu ft of practically pure methane per day, and he quotes the reserves of natural gas as being some 600 million cu ft. In the Wartime Pamphlet No. 45, published by D.S.I.R., Geological Survey of Great Britain, in April 1945, the greatest authority on the Mineral Resources of the Lothians, Dr. A. G. MacGregor, M.C., D.Sc., states that between 1937 and 1940 over half-a-dozen wells were sunk in the D'Arcy–Cousland area (Midlothian), as a result of which at least 15 million cu ft of gas and about 1 ton of oil per day were made available as the combined yield of two of the wells. Neither Dr. MacGregor, nor the Oil Industry, has given any figure, even tentatively, for possible reserves, for the obvious reason that no natural gas well has been on production long enough in Great Britain to enable a reliable estimate to be made.

Assuming that a steady yield of 15 million cu ft of natural gas could be made available at a suitable site for a sufficient number of years to justify the capital expenditure for a carbon-black plant to be installed in Scotland, the total yield of carbon-black would amount to less than one-quarter of that imported into Great Britain from U.S.A. in 1945 for the Rubber Industry alone.

The latter half of the booklet, which deals with the production of various chemical products from natural gas is disappointing. For the most part it is scrappy and incomplete. It is difficult to see what useful purpose this rapid survey of the subject will serve other than as condensed revision notes for University students. It will be of little practical use to an industrial chemist or chemical engineer in planning for the production of chemicals from methane.

Nearly one-fourth of the booklet is devoted to a digest of recent C.I.O.S. reports describing the German Arc Process for the production of acetylene from natural gas. This is out of proportion to the space given to other chemicals from methane, and may be the reason why some have been omitted altogether.

The booklet is well printed on the whole and is in clear type. The printed descriptions which appear in some of the greatly reduced diagrams (notably Figs. 1 and 3) are much too small to be legible without the use of a magnifying glass.

Attention should be called to a serious mistake on page 21, where it is stated that natural gas in U.S.A. usually contains up to 2% of helium. This is incorrect because a helium-rich natural gas in the United States is the exception and not the rule. Most of the natural gas contains no helium at all, or at most only a trace.

The author rightly states in his concluding paragraph that a considerable amount of research into the use of natural gas has obviously been proceeding. His final remark is that "one fact is patent—a potential industry of considerable importance is literally on our doorstep. It must not be ignored."

Dr. Lawrie is evidently unaware of the fact that the possibility of utilizing natural gas in the United Kingdom for this and other purposes has already been thoroughly explored by the oil industry, and also by the Special Wartime Committee on the utilization of methane appointed by the Government. W. H. C.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	170 A
Geophysics and Geochemical Prospecting	174 A
Drilling	175 A
Production	177 A
Oilfield Development	178 A
TRANSPORT AND STORAGE ...	179 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	180 A
Distillation	181 A
Cracking	181 A
Alkylation	182 A
Special Processes	182 A
Refining Patents	182 A
Safety Precautions	184 A
PRODUCTS.	
Chemistry and Physics ...	184 A
Analysis and Testing	186 A
Gas	187 A
Gas Oil and Fuel Oils	187 A
Lubricants	187 A
Derived Chemical Products ...	190 A
Miscellaneous Products ...	190 A
ENGINES AND AUTOMOTIVE EQUIPMENT	190 A
MISCELLANEOUS	191 A
BOOK REVIEW	193 A
BOOKS RECEIVED	193 A

AUTHOR INDEX.

The numbers refer to Abstract Numbers.

Anderson, W. W., 707
Arand, A. G., 762
Archie, G. E., 696
Aschner, E., 715
Axe, W. N., 727

Baisley, J. R., 697
Bare, P. O., 732
Barsoni, C. B., 706
Beach, F. K., 691
Bench, B. M., 686
Bennett, D. A., 706
Boggess, H. W., 726
Bower, T. H., 683
Brancker, A. V., 738
Brandon, C. W., 718
Brandon, G. M., 718
Brown, H. S., 706
Brown, W., 701
Brumbaugh, A. K., 720
Burk, R. E., 727

Cantrell, T. L., 718
Carter, A. S., 733
Cashman, A. F., 727
Cavaness, J. D., 707
Childers, R. O., 706
Clark, J. B., 706
Claussen, W. H., 737
Claxton, C. R., 745
Clay, J. A., 703
Cohee, G. V., 685
Collins, M. M., 727
Connors, J. S., 727
Cowles, L. G., 706
Crawford, C. C., 727
Crits, J. S., 709
Cross, R. J., 717
Curtiss, L. F., 706

De Golyer, E., 746
De La Mater, R. G., 707
Delion, R., 721
Demmerle, R. L., 725
Devaney, L. W., 727
Dougherty, P. F., 706

Eastman, B., 727
Evans, T. W., 727

Fagin, K. M., 699
Farmer, E. H., 733
Farris, R. F., 706
Fiaber, S. T., 718
Foster, J. L., 707
Foster, T. R., 719
Frey, F. E., 737
Frishman, L. E., 704
Furth, M. A., 706

Gassett, P. L., 707
Gilmartin, T., 706
Givandon, J., 721
Glover, R. C., 706
Goepfert, O., 736
Gosselin, A., 757
Granberg, A. J., 718
Grenko, J. D., 727

Hall, G. W., 706
Harper, O. D., 707
Harper, R. L., 707
Hart, E., 718
Higgins, J. H., 718
Hill, F. B., Jr., 732
Hockberger, W. G., 722
Hooser, D. B., 706, 707
Howard, P. A., 718
Hughes, E. C., 727
Hurka, V. R., 732
Husted, C. A., 707
Hutchison, F. E., 706

Imlay, R. W., 687
Ipatieff, V. N., 727
Ives, G. O., 693

Jacque, L., 721
Jenkins, F. W., 707
Johns, H. F., 707

Kellett, J., 724
Kennedy, H. T., 707
Kilpatrick, E., 730
Kind, F., 726
Korpi, K. J., 731
Kowalski, F., 707
Krsanow, S., 706

Lacey, W. N., 731
Landoni, A., 763
Landrum, H. B., 707
Latchum, J. W., Jr., 727
Leach, S. J., 743
Lieber, E., 727
Long, L. H., 734

Maier, A. R., 709
Markle, M. G., 745
Mayland, H. C., 727
McClennan, L. W., 751
McCullough, O. J., 707
McGlone, J. F., 707
McKee, E. D., 683
McKinley, C., 756
Meilert, D. V., 745
Meyer, J. B., 707
Mighton, C. J., 732
Millington, J. W., 706
Monroe, G. S., 727
Monson, L. T., 707, 740
Moore, P. H., 743
Morrison, G. O., 727
Mowrey, L. D., 707
Murphy, E. T., 729

Naragon, E. A., 727
Nelson, W. L., 716, 741
Nickle, C. O., 692
Nixon, I. G., 727
Norrish, R. G. W., 734

O'Kelly, A. A., 724
Ospina-Racines, E., 764
Owner, F. M., 759
Ozanne, H., 713

Patterson, R. J., 727
Patton, L. T., 688
Perrin, M., 737
Peters, J. G., 718
Petty, O. S., 698
Pinion, T. N., 706
Pitzer, K. S., 730
Plucker, J., 734
Powell, T. M., 727

Read, A., 705
Reamer, H. H., 731
Richter, C., 727
Roberts, C. H. M., 727
Rossini, F. D., 739
Rupp, W. H., 707

Sage, B. H., 731
Sanders, P. A., 733
Sanderson, J. O. G., 690
Sanderson, R. T., 727
Scherbatskoy, S. A., 698
Schildknecht, C. E., 756
Schmerling, L., 727
Schmitt, P., 721
Scott, C. H., 718
Scott, P. H., 718
Sedlak, V. A., 739
Segelhorst, A. L., 706
Sen Gupta, N. C., 705
Sens, R. F., 706
Sharp, J. W., 706
Sheets, M. M., 684
Shinomiya, S., 706
Silverman, D., 706
Skelton, W. E., 748
Smith, H. G., 718
Sneddon, R., 702
Starkweather, H. W., 733
Starr, C. E., 722
Starret, H. A., 718
Stelzer, W., 706
Stephens, F. M., 727
Stewart, A. H., 754
Stipp, T. F., 689
Stokes, J. C., 706
Strawn, L. R., 727
Streiff, A. J., 729
Suter, H. H., 681

Taylor, J. K., 739
Taylor, R. G., 706, 707
Tcherkesoff, N., 735
Telfer, A. H., 695

Tilton, J. A., 722
Thompson, R. B., 727
Thornbury, S. G., 718
Van Ess, P. R., 727
Van Vorst, J. P., 700
Vellinger, E., 744
Veltman, P. L., 727
Walker, H. W., 732
Watson, F. J., 727
Webber, W. O., 707
Weissenberg, K., 749
Whalley, H. K., 742
Whitney, G. M., 727
Williams, P. S., 706
Willingham, C. B., 729
Wineman, W. H., 707
Winn, W. E., 706
Wolf, A., 706, 755
Worth, H. J., 751
Wright, R. O., 707
Yabroff, D. L., 727
Youker, M. A., 732
Zanetta, A., 763
Zoss, A. O., 75

Oilfield Exploration and Exploitation.

Geology.

681. Exaggeration of Vertical Scale of Geologic Sections. H. H. Suter. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 318.—Many sections drawn in the study of petroleum geology are constructed with an exaggerated vertical scale. The author analyses the frequency of such exaggerations in the literature and points out the serious distortional effects which result. It is suggested that exaggerated sections should be replaced by true sections and when the depiction of areas of flat geology or large basins is undertaken, an accurate presentation can be made by coupling a true geologic section with a stratigraphic section. E. N. T.

682. Log Map, New Type of Sub-surface Map. T. H. Bower. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 340.—In 1938 A. L. Payne developed a sand-distribution map which was the prototype of the present log map. This is essentially a structure contour map, whereon the lithological variations are depicted by a series of electric or other logs.

As with all attempts to depict three dimensions on a two-dimensional surface, this type of sub-surface map has certain limitations. However, it has been found particularly useful as a method of analysis in sub-surface geology, particularly in an area such as Trinidad, where the complex structural and stratigraphical conditions could not be accurately defined by the older conventional types of map. E. N. T.

683. Palæozoic Seaways in Western Arizona. E. D. McKee. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 282.—A study has been made of gravels derived from rocks of various pre-Mesozoic periods and preserved as conglomerates in Cretaceous (?) strata in the New Water Mountains of Western Arizona. These gravels, having been little transported, furnish data regarding the former distribution of Palæozoic rocks in the region.

In the conglomerates, rocks of Cambrian, Devonian, Mississippian, Pennsylvanian (?), and Permian age have been recognized. The relationship of these rocks to strata of corresponding age in the formations of northern and southern Arizona is discussed.

Lithology and fossils of the gravels indicate that this part of west-central Arizona was covered by marine waters at various times from the Middle Cambrian to the Late Pennsylvanian. All these seaways are believed to have extended into the western Grand Canyon, and some may have connected with those of corresponding age in southern and southeastern Arizona. E. N. T.

684. Diastrophism During Historic Time in Gulf Coastal Plain. M. M. Sheets. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 201.—There are evidences of five kinds of diastrophic activity in the Gulf Costal Plain—earthquakes, fissuring and faulting, regional warping, local subsidence and uplift, and pseudo-diastrophic features.

Earthquakes, which have taken place fairly frequently in the past, are also to be expected in the future. There have been many reports of fissuring and faulting in recent years, of which the author has investigated a considerable number. A few items of warping are described. Local subsidence and uplift, frequent in the past, are taking place in some regions to-day—for instance, the Hoskins Mound salt dome appears to have risen ½ ft in 23 years.

The diastrophism in the Gulf Coast can be largely ascribed to the force of gravity, but it is also influenced by two important local features—inequalities in support and large variations in density. It is suggested that the resultant warping might be caused by waves in the earth's crust travelling at geologically slow speeds.

The Basin of the Gulf of Mexico is an area of active diastrophism. More attention and study should be devoted to the subject. There is much more evidence to be

obtained and correlated, and the search can be facilitated by the use of aerial photography.

It is hoped that publicity on the subject will bring forth further evidence.

E. N. T.

685. Cambrian and Ordovician Rocks in Recent Wells in Southeastern Michigan. G. V. Cohee. *Bull. Amer. Ass. Petrol. Geol.*, 1947, 293.—In the Southern Peninsula of Michigan all the wells drilled to the pre-Cambrian lie within five counties in the southeastern area of the State, near the Ontario boundary.

The depth to the pre-Cambrian ranges from 3300 ft to 6400 ft. The thickness of the Middle Ordovician varies from 660 ft to 965 ft, and that of the Upper Ordovician from 585 ft to 750 ft.

Oil is produced from Middle Ordovician rocks in Kent County, Ontario, and in small areas of the Upper Trenton limestone in Lenawee, Monroe, and Wayne Counties, Michigan. There are Upper Cambrian rocks, of thickness varying from 1160 ft to 140 ft, resting on the pre-Cambrian in southeastern Michigan. The Cambrian, however, is missing in most of southwestern Ontario, where the Middle Ordovician directly overlies the pre-Cambrian.

There are showings of oil and gas in Upper Cambrian rocks of southeastern Michigan and southwestern Ontario.

E. N. T.

686. Rangely Field Geology and Development. B. M. Bench. *Oil Wkly*, 2.9.46, 123 (1), 18.—The Rangely structure was recognized before 1900. Seepages occur and in 1902 a well found a little oil in the Mancos shale at 750 ft and shows at 1700 ft. Some 350–400 wells have been drilled to the Mancos, but not many found significant production. The Mancos oil is in cracks and crevices. Large flows of gas were found in a few wells drilled to the Dakota sandstone. Oil saturation and gas shows have been noted in the Morrison. In 1933 the Raven 1 well found gas in the Dakota and Nugget, and oil in the Weber sand (Pennsylvanian). This well was shot, and after producing 8000 brl it was shut in until 1943.

The Rangely anticline is 20 ml long and 8 ml wide. It runs N. 70° W. Mancos shale is exposed on the crest. The closure exceeds 2100 ft. The northeast flank dips at 6°, and the southeast flank at 13–21°.

Sandstones occur in the top and bottom of the Mancos shale. The Dakota includes shales, sandstone, conglomerate, and some limestone, while the Morrison consists of shale, clay, limestone, and sandstone. The remaining Jurassic beds include limestone, sandstone, and shale. Some 820 ft of Triassic shale, sandstone, and gypsum is present, and 130 ft of Permian shale, sandstone, and limestone. The Weber sandstone is at the top of the Pennsylvanian. Oil-bearing sands occur in the upper part of the Weber.

The sub-surface structure appears to be gentler than the surface structure. Some faults are present. The Mancos shale oil occurrence is related to fracture zones, and the oil may be indigenous. The Weber oil is anticlinal. Only one well has found a substantial flow of oil in the Morrison. Some gas and oil have been found in the Trias.

Weber sand wells have potentials of 100–1000 brl/day. The G.O.R. is 250–300 cu ft/brl. 82 Weber sand wells have been drilled, their June average production being 26,000 brl/day. Over 2,000,000 brl of Mancos oil has been produced. Weber wells range $100,000–$250,000 and average $125,000 in cost. The oil-producing area is expected to exceed 25,000 acres, and ultimate recovery estimates range 5000–25,000 brl/acre.. The best wells occur in the northern and northwestern areas. All the wells flow, but some require shooting first. The gas contains 11–27% of nitrogen. The average depth of Weber sand wells is 6300 ft.

Notes are given on drilling practice, land status, markets, and future developments. A map and cross-section are included.

G. D. H.

687. Marine Jurassic of Black Hills Area, South Dakota and Wyoming. R. W. Imlay. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 227.—The Marine Jurassic in the Black Hills area includes the Sundance and Gypsum Springs formations. The former represents the Callovian and Oxfordian stages of the Middle and Upper Jurassic, the latter the Upper Bajocian and Bathonian stages.

The Sundance formation is subdivided into five members, of which the upper is marked basally by an unconformity. These are described, from the lowest upwards, as the Canyon Springs sandstone member, the Stockade Beaver shale member, the Hulett sandstone member, the Lak member, and the Redwater shale member.

The Gypsum Spring formation, which is Middle Jurassic in age, and correlative with the Gypsum Spring and Sawtooth formations of Central Wyoming and Western Montana, represents the first widespread invasion and withdrawal of marine water during the Jurassic in the Western Interior region.

The Canyon Springs sandstone member and the Stockade Beaver shale member, which are of Upper Jurassic age, can be correlated with the Sundance and Rierdon formations of Central Wyoming and Montana. The Hulett sandstone member, which is correlative with the " Lower Sundance " formation in Central Wyoming, is probably also present in South Dakota and southeastern Montana, although it is not to be found in the outcrop in Montana. The Lak member, which consists of redbeds, appears not to be marine; it is correlative in part with the Entrada and Preuss sandstones to the west. It also has not been identified in Montana, but may be present in North Dakota. The Redwater shale member represents the last Jurassic marine invasion in the Western Interior region. Oxfordian in age, it is correlative with the Swift, Stump sandstone, Curtis, and " Upper Sundance " formations further west. E. N. T.

688. Modal Analyses of Well Cores from Basement Complex in West Texas. L. T. Patton. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 307.—The results of studies of cores from ten wells in ten different counties of West Texas are presented. The modes of the rocks are computed from Rosiwal mineralogical analyses, and an improved Wentworth recording micrometer graduated to read to 0·005 mm was employed in measuring the mineral grains.

Classifications are made according to the Johannsen quantitative minerological system. E. N. T.

689. Palæozoic Formations near Cody, Park County, Wyoming. T. F. Stipp. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 274.—Palæozoic strata ranging in age from Cambrian to Permian are exposed in Shoshone River Canyon, 5 ml west of Cody. These formations have been drilled in the Oregon Basin, and a study was made of the area as an aid in the administration of the Federal mineral-leasing laws.

The average thickness of the section measured is 3200 ft. Up to date no Silurian strata have been recognized.

A well recently drilled 17 ml southeast of Shoshone Canyon penetrated a Palæozoic section approximately 3000 ft thick. The well cores and bit cuttings on examination showed the well section to be similar to the surface section. There are indications that the well section thins slightly southeastward from the mountains. A chart showing the correlation of the two sections is attached to this paper. E. N. T.

690. Progress of Petroleum Geology in Western Canada in 1945. J. O. G. Sanderson. *Canad. Min. metall. Bull.*, June 1946, **49**, 256.—G. A. Dawson was Canada's first petroleum geologist, and he caused the Government to drill several wells between 1890 and 1900, resulting in the discovery of the Pelican gas-field in 1897. He trained several men. F. G. Clapp was engaged to carry out work in 1912 and was assisted by L. G. Huntley. Considerable contributions to the petroleum geology of western Canada were made by members of the Geological Survey of Canada and the Research Council of Alberta.

Before the depression of the early 1930's several fields were discovered. Viking (1923), Wainwright (1926), Skiff (1927), Coutts (1929), Kinsella (1930), and Twin River (1931). Effective search for oil was resumed in 1936 and further discoveries were made: Del Bonita, Taber (1936), Princess (1938 and 1944), Lloydminster (1938 gas, 1944 oil), Vermilion (1939), Brazeau (1940), Jumping Pound (1944), Unity (1944), Conrad (1945), and West Coutts (1945).

Before 1924 it was generally believed that only the Mesozoic held commercial amounts of hydrocarbons, but the discovery of Turner Valley changed the picture. Later it was shown that the Devonian of the foothills was a source and reservoir rock. The area in which the Madison limestone occurs is probably quite small. The Devonian

may be the source of oil found in the Lower Cretaceous in Alberta and Saskatchewan. The Colorado shale may be a source rock.

Recently oil has been found in the Madison on the plains. This formation may be productive in southern Saskatchewan. The Unity area has closure of 70–100 ft over several thousand acres. Undoubtedly there were pre-Mesozoic structures.

During the past 20 years practically all of the plains area and most of the foothills from Wapiti river to the International boundary have been studied and mapped by the geological departments of many oil companies. G. D. H.

691. Brazeau Area, Alberta, Shows Promise. F. K. Beach. *Petrol. Engr*, June 1946, 17 (9), 74.—In 1940 a well on the Brazeau structure was abandoned at 8728 ft, after meeting a fault which dropped down the Madison. A pocket of gas was met. In 1945 a second test found the Madison at 9498 ft, passed through a fault at 9595 ft, re-entered the Madison at 11,599 ft and was in younger beds when drilling stopped at 11,689 ft. After acidizing, the shallower Madison "Splinter" gave 10,000,000 cu. ft. of gas/day. G. D. H.

692. Operation Muskeg. C. O. Nickle. *Oil Wkly*, 2.9.46, **123** (1), 13 (*International Section*).—The Muskeg Anticline of the north central foothills of Alberta is regarded as promising. The Madison limestone at about 10,000 ft is the objective. Geological and seismic work has been done. G. D. H.

693. Oil in Colombia's Llanos Region. G. O. Ives. *Oil Wkly*, 2.9.46, **123** (1), 16 (*International Section*).—Physically and topographically the Llanos region resembles the eastern Venezuelan oil region. Transportation is a serious problem and it is estimated that for economically sound operations a reserve of at least 1,000,000,000 brl must be found. This figure is based largely on the cost of a pipeline over the Andes ($150,000,000 for installation alone). Production must be at the rate of at least 100,000 brl/day to recover this reserve in the 30-year period allowed for exploitation.

The Llanos are covered largely by Pleistocene and Miocene deposits. Field work is very difficult between July and December because of the weather. Tropical is to drill a 12,000-ft test on the Meta river. Shell abandoned San Martin 2 at 6810 ft after testing. It gave some 14-gravity oil. Showings have been found on the Chafurray concession 125 km southeast of San Martin, Chafurray 5 having encountered tar sands. Four earlier wells were dry, and averaged 2500 ft in depth. Both San Martin and Chafurray are on seismograph anomalies. G. D. H.

694. Shell Opens New Field in Western Venezuela. Anon. *Oil Wkly*, 2.9.46, **123** (1), 28 (*International Section*).—Shell's West Tarra 2, near the Colombian border, west of the southern end of Lake Maracaibo, has found commercial oil production in the top of the Cretaceous limestone at about 7000 ft. It is estimated that the rate of flow was 2000 brl/day of 42-gravity oil. The limestone seems to be similar to that which produces northwest of the lake.

West Tarra 2 lies on a structure west of the Tarra Ridge on which the La Manueles, Tarra, and Las Cruces fields lie. Most of the production on the Tarra Ridge anticline is controlled by faulting and comes from the Eocene. Some 95,000,000 brl of oil has been obtained in 20 years.

The West Tarra structure was revealed by geological and geophysical work. G. D. H.

695. Western Australia. A. H. Telfer. *Oil Wkly*, 2.9.46, **123** (1), 8 (*International Section*).—Small oil shows have been noted in the eight wildcats drilled in Western Australia since 1921. The Ord River in East Kimberley area shows downfaulted blocks of Devonian and Permian sediments in an area of Cambrian sediments with lava flows. Devonian outcrops occur in the Desert Basin beneath unconformable Permo-Carboniferous beds which dip south. Tests in the northern section of this basin have shown oil traces. Permo-Carboniferous beds and seemingly favourable structures are known in the northwest Basin, but no drilling has been done. Mesozoic and Cainozoic beds are present. Reports of oil indications in the Coastal Basin are unconfirmed. The Eucla Basin has Miocene and Cretaceous beds. No signs of oil have been found. A map and summary of drilling results are given. G. D. H.

Geophysics and Geochemical Prospecting.

696. Electrical Resistivity an Aid in Core-analysis Interpretation. G. E. Archie. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 350.—The electrical resistivity of a rock is closely related to porosity, and the actual type of rock structure has remarkably little effect on this factor provided the rock is well consolidated.

Rocks are heterogeneous in their nature, but although their characteristics cannot be expressed by limited mathematical formulæ, there are certain definite trends which can be followed. Electrical resistivity can be used in a quantitative way in core-analysis interpretation. E. N. T.

697. Airborne Magnetometer. J. R. Balsley. *Petrol. Engr*, July, 1946, **17** (11), 77; Aug., 1946, **17** (12), 104.—The airborne magnetometer now in use for geophysical surveys consists of a magnetic detector and a device for correlating the magnetic record with the plane's position in space. The total magnetic flux is measured electronically and recorded on a chart, commonly at ½–2 ml/inch. The sensitivity is instantly variable by a selector switch. The instrument is towed in a streamline "bird" or housed in a special non-magnetic tail section of a plane. The plane's position may be obtained in several ways. One method employs a gyroscopically stabilized sonné continuous strip camera and a recording radio altimeter. For unmapped or water-covered areas the Shoran radio navigation aid is used.

The most effective flight pattern is usually a series of parallel traverses flown at right angles to the geological grain. At least two traverses should cross each anomaly, but it is generally impracticable to use traverses less than ¼ ml apart. The flights should be at a mean constant height above ground. Experience indicates that 1000 ft is a suitable height. Traverses 25–50 ml in length are satisfactory. In detailing flights may be made at more than one level. The runs are eventually plotted on a map.

A mechanical device has been built for dealing with sensitivity and base value changes for the magnetic record, variation in plane speed, etc., and by means of it continuous magnetic profiles are prepared. In order to correlate the traverses base lines are flown at right angles to them near their ends. Magnetic contour maps can then be compiled.

A flying speed of 150 m.p.h. has proved satisfactory, giving about 100 ml of traverse per hr. A four-man crew can then cover 7500–10,000 ml of traverse per month since 75–100 hr of flying per months is a reasonable average. During May and June, 1945, such a crew covered 3170 sq ml in the Adirondacks with 1300 ml of traverse. The cost of an equivalent ground survey would be seventeen times greater and would occupy twenty-seven 6-month field seasons with a four-man crew. The ground survey would be less detailed and less accurate. Office compilation times may be about the same for ground and airborne surveys.

In airborne surveys some of the difficulties arising from drift and diurnal variation are minimized; disturbances due to pipes, etc., are reduced; on any traverse no anomaly can be missed due to improper station spacing; measurements at two heights improve the interpretation.

Airborne surveys do not replace the normal surveys, but serve to show where the latter will be most valuable, especially when close traverse spacing is needed. The overhead expenses of airborne surveys are high, and so they are uneconomic for small areas.

Maps showing the results of some surveys are included. G. D. H.

698. Geophysical Patents. O. S. Petty. U.S.P. 2,408,478, 1.10.46. Seismic Apparatus and Method.—A portable seismometer responsive only to vertical components of seismic waves.

O. S. Petty. U.S.P. 2,410,303, 29.10.46. Seismic Surveying.—A means for transforming seismic energy into electrical energy, and for recording same.

S. A. Scherbatskoy, assr to Seismic Engineering Co., U.S.P. 2,411,117, 12.11.46. Seismometer.—A geophone for translating earth vibrations into corresponding electrical oscillations: two independently supported plates immersed in a conductive liquid are caused to vibrate by earth tremors, thus varying the resistivity of the liquid between them and causing fluctuations in an electric circuit. R. B. S.

Drilling.

699. Magnolia Drills for Oil in the Gulf of Mexico. K. M. Fagin. *Petrol. Engr*, Nov. 1946, **18** (2), 82.—An account is given of the drilling of the Magnolia Petroleum Company's Louisiana Gulf (Block 58) No. 1 well 30 ml offshore in the Gulf of Mexico. The layout and construction of the drilling platform and the systems of supply and communication are described. R. B. S.

700. Nine Speed Drilling Rig Air-Operated. J. P. Van Vorst. *Petrol. Engr*, Nov. 1946, **18** (2), 184.—A new type of drilling rig having six major assemblies is described. These assemblies are: (1) draw-works, (2) nine-speed transmission, (3) three-engine compound unit, (4) three 330 h.p. engines, (5) substructure, and (6) two mud pumps. The clutches, brakes, transmission controls, etc., are operated by compressed air; the bearings are pressure lubricated, and the chain links are continually sprayed with oil. R. B. S.

701. Graphic Method of Selecting Roller Chain Drives for Multiple Speed Transmissions. W. Brown. *Petrol. Engr*, Nov. 1946, **18** (2), 156.—A graphical method is devised for designing chain drives. The chain length in pitches and the number of teeth required on the large sprocket and on the small sprocket can be determined by this method for a given sprocket ratio and a given centre distance between sprockets. The method is illustrated by an example. R. B. S.

702. Blowout Subdued Under Difficult Conditions. R. Sneddon. *Petrol. Engr*, Nov. 1946, **18** (2), 134.—The control of a blowout on the Havenstrite Barnes No. 1 well at Del Valle, in which the annulus between the 11¾-in surface string and the 7-in oil string had built up a pressure which caused the surface equipment to fail, is described. R. B. S.

703. Use of Formaldehyde to Inhibit Corrosion. J. A. Clay. *Petrol. Engr*, Nov. 1946, **18** (2), 111.—Formaldehyde is a satisfactory inhibitor in cases of corrosion due to hydrogen sulphide saturated brines and to acids at low temperatures. When corrosion is due to other causes (*e.g.* electrolytic currents) formaldehyde does not inhibit corrosion: this explains its apparent ineffectiveness in many cases where it has been declared a failure.

Three types of formaldehyde injection systems are described and illustrated. The amount of formaldehyde to be used must be scientifically determined for each well. This varies according to the amount of surface area, since it is believed that the inhibiting action of formaldehyde is due to the formation of an extremely thin protective layer on the surface of equipment by its reaction with the sulphides in the well fluids. The amount of formaldehyde to be used also depends on (1) the dilution effect of the produced fluids (this being a function of the amount of water produced), and (2) the severity of corrosion (this being a function either of the amount of hydrogen sulphide dissolved in the water or of the acid characteristics of the water). An initial injection of 2 to 5 gal is usually required, and thereafter up to ½ gal per 100 brl of water produced. Excessive amounts of formaldehyde are not damaging, but the inhibiting action is not increased in proportion to the increased expenditure. R. B. S.

704. Plastic Coating Inside Surface of Drill Pipe to Combat Corrosion Fatigue Failures. L. E. Frishman. *Petrol. Engr*, Nov. 1946, **18** (2), 194.—The corrosion fatigue failures of drill pipe always start on the inside, and in any case coating on the outside of the pipe would soon be polished off during drilling: hence coating the outside as well as the inside of the pipe would add little to the prevention of corrosion fatigue failures. Certain protective coatings applied to the outside of the pipe would also cause "gumming up" of the jaws of tools applied to the outside of the pipe. Suitable protective coating for the inside of pipe should have the following properties: (1) it should be impervious to water, (2) resistant to oil, (3) resistant to chemical attack by drilling mud and underground waters, (4) it should not soften or deteriorate at bottom-hole temperature, (5) it should be resistant to mild abrasion, (6) it should not be brittle, (7) it must be chemically stable and must not oxidize in contact with air, (8) it must

adhere well to the surface of the pipe, (9) it must not change the physical properties of the surface of the pipe, and (10) it must be easy to apply inside the pipe.

The properties of many coating materials were examined and suitable ones (which fulfilled the above ten requirements) were tested under corrosion fatigue conditions. The methods of testing and the results obtained are described in detail. Both field tests and laboratory experiments showed that a thermo-setting phenolic-base plastic applied to the inside of pipe will substantially prevent corrosion fatigue failures. A definite endurance limit is obtained for coated test-bars under corrosive conditions in the laboratory. R. B. S.

705. Effect of Sodium Hexametaphosphate on the Yield Value and Viscosity of a Hydrogen Bentonite Solution. A. Read and N. C. Sen Gupta. *Nature*, 1947, **159**, 336.—Previous work on the treatment of drilling muds has established the effect of phosphates on the apparent viscosity of clay suspensions. In the present experiments various concentrations of sodium hexametaphosphate have been added to a 10% solution of hydrogen bentonite suspension, and the yield values and apparent viscosities of the system measured over a period of 20 days. Results are (1) the yield value is reduced to a greater extent than the viscosity by phosphate, (2) whilst the viscosities increase on standing the yield values at phosphate concentrations of 0·6–0·8% do not. The hypothesis that the phosphate ion enters the clay complex explains the reversion of viscosity to its original figure, but not the constancy of the low yield value.

H. C. E.

706. Drilling Patents. W. Stelzer. U.S.P. 2,407,856, 17.9.46. Hydraulic Brake Mechanism.—A brake-operating mechanism for a hydraulic brake system having a hydraulic brake cylinder and a pedal-controlled master cylinder.

P. S. Williams, assr to Standard Oil Development Co. U.S.P. 2,408,012, 24.9.46. Well Logging.—A method of well logging consisting of an apparatus which delivers sharp hammer-like blows against the walls of the well, and at the same time generates electrical impulses which are a function of the resistance of the formations in the walls of the well to these blows. These impulses are transmitted to the surface and logged.

C. B. Bazzoni and J. W. Millington, assrs to Sperry Sun Well Surveying Co. U.S.P. 2,408,029, 24.9.46. Electrical Prospecting Apparatus.—An electrical well-logging device in which a high frequency alternating current is produced in a coil adjacent to the walls of the bore-hole.

D. A. Bennett and A. R. Maier, assrs to Oil Well Supply Co. U.S.P. 2,408,364, 1.10.46. Rotary Drilling Unit.—A unit combining a prime mover, a rotary unit, and a means for separately interrupting the transmission of power from the prime mover to the rotary automatically.

F. E. Hutchison. U.S.P. 2,408,558, 1.10.46. Mud Screen.—A special type of screen for sifting cuttings from rotary drilling mud.

J. C. Stokes, assr to Reed Roller Bit Co. U.S.P. 2,408,892, 8.10.46. Slush Tube.—A special type of rotary drilling bit.

W. E. Winn and P. F. Dougherty, assrs to Sun Oil Co. U.S.P. 2,408,964, 8.10.46. Method of Logging Wells.—A well-logging method which consists of passing a gas through the drilling mud to remove hydrocarbons, and then analysing the effluent to determine the amount of these hydrocarbons originally present in the mud.

W. E. Winn and P. F. Dougherty, assrs to Sun Oil Co. U.S.P. 2,408,965, 8.10.46. Method of Logging Wells.—A well-logging method which consists of separating cuttings from the drilling mud, mixing them with carbon dioxide under pressure, applying vacuum, thus removing hydrocarbons with the carbon dioxide and subjecting this gas mixture to analysis, thus ascertaining the content of these hydrocarbons in the formation from which the cuttings were obtained.

S. Krasnow and L. F. Curtiss, assrs to Geophysical Development Corpn. U.S.P. 2,409,436, 15.10.46. Method and Apparatus for Direct Recording of Borehole Radioactivity.—A method of measuring borehole radioactivity involving an apparatus which consists of a radioactive sensitive element and a means of indicating this radioactivity at the surface.

R. G. Taylor and D. B. Hooser, assrs to the Guiberson Corpn. U.S.P. 2,409,811, 22.10.46. Setting and Releasing Tool.—A tool adapted to lower a member to be set into a well.

R. F. Farris and J. B. Clark, assrs to Stanolind Oil and Gas Co. U.S.P. 2,410,278, 29.10.46. Water Locating System.—A method of locating a zone of ingress of conducting fluid to a well producing both conducting and non-conducting fluids (*e.g.* water and oil).

A. L. Segelhorst. U.S.P. 2,410,589, 5.11.46. Automatic Slip Mechanism.—Automatic slips for supporting rotary drill pipe, etc.

S. Shinomiya (vested in the Alien Property Custodian). U.S.P. 2,410,753, 5.11.46. Drilling Device.—A flexible drilling collar enabling the bottom of a bore-hole to be drilled to a larger diameter than that of the bore-hole itself.

J. W. Sharp, assr to Permancute Cement Co. U.S.P. 2,410,954, 12.11.46. Silica Modified Cement.—A hydraulic cement containing very finely divided silica.

H. S. Brown. U.S.P. 2,410, 959, 12.11.46. Earth Drill.—A portable truck-mounted drilling unit.

G. W. Hall, R. F. Sens, and M. A. Furth, assrs to The Pure Oil Co. U.S.P. 2,411,209, 19.11.46. Bit.—A special type of elongated drilling bit.

R. C. Glover and R. O. Childers, assrs to Baker Oil Tools Inc. U.S.P. 2,411,260, 19.11.46. Apparatus for Supporting and Cementing Liners or Casings in Well Bores.

A. Wolf and L. G. Cowles, assrs to The Texas Co. U.S.P. 2,411,311, 19.11.46. Well Sounding Apparatus.—A means for recording pressure impulses from a well.

T. N. Pinion. U.S.P. 2,411,589, 26.11.46. Boiler Water Feed Device.—A device for automatically filling a steam boiler.

D. Silverman and T. Gilmartin, assrs to Stanolind Oil and Gas Co. U.S.P. 2,411,696, 26.11.46. Well Signalling System.—An electro-magnetic method of well logging.

R. B. S.

Production.

707. Production Patents. L. T. Monson, W. W. Anderson, and F. W. Jenkins, assrs to Petrolite Corpn Ltd. U.S.P. 2,407,895, 17.9.46. Process for Resolving Water in Oil Emulsions.—A demulsifying process in which the emulsion is subjected to the action of a surface-active heat-polymerized amino-alcohol.

O. D. Harper, assr to Standard Oil Development Co. U.S.P. 2,407,983, 24.9.46. Completion of Wells.—A multiple completion method using a casing having separable sections corresponding to the producing horizons: the lowermost section is cemented just above the lowermost producing horizon and the remainder disengaged and raised until its lowermost end is adjacent to the top of the next highest producing horizon, where it is then cemented, and so on.

O. J. McCullough, assr to McCullough Tool Co. U.S.P. 2,407,991, 24.9.46. Pipe Releasing Device.—An apparatus for unthreading sections of well tubing within a well bore.

W. H. Wineman, assr to Joy Manufacturing Co. U.S.P. 2,408,013, 24.9.46. Pumping Apparatus.—A hydraulically operated sucker-rod pumping unit.

F. Kowalski and R. L. Harper. U.S.P. 2,408,075, 24.9.46. Oil Well Pump.—A pumping unit operated by gas pressure.

R. G. De La Mater, assr to The Parkersburg Rig and Reel Co. U.S.P. 2,408,200, 24.9.46. Walking Beam Structure.—A special type of walking beam structure for sucker-rod pumping rigs.

J. L. Foster. U.S.P. 2,408,419, 1.10.46. Well Explosive Device.—A well-shooting device employing explosive projectiles.

J. F. McGlone. U.S.P. 2,408,795, 8.10.46. Control Means.—A control means for a double-acting fluid pressure motor.

W. O. Webber, assr to Standard Oil Development Co. U.S.P. 2,409,005, 8.10.46. Treating Emulsions.—A method for treating salt-bearing crude oil consisting of heating, adding water, and agitating to remove salts in the oil, and then removing the water by a filtering and settling process.

J. D. Cavaness. U.S.P. 2,409,104, 8.10.46. Sucker Rod Tightener.—A mechanical device for tightening sucker rods.

R. G. Taylor and D. B. Hooser, assrs to The Guiberson Corpn. U.S.P. 2,409,812, 22.10.46. Control Head Packer.—A removable packer device.

J. B. Meyer. U.S.P. 2,410,354, 29.10.46. Fluid Pressure Pump.—A hydraulically operated pump suitable for use in wells.

H. F. Johns, assr to V. V. Johns. U.S.P. 2,410,976, 12.11.46. Oil Well Pump Packing.

H. B. Landrum and C. A. Husted, assrs to The Texas Co. U.S.P. 2,411,044, 12.11.46. Paraffin Removal.—A method of removing paraffin from the inside of tubing, etc., by forcing with oil through the tubing a solid body of naphthalene which gradually dissolves.

L. D. Mowrey. U.S.P. 2,411,667, 26.11.46. Bottom-Hole Regulator.—A bottom-hole flow regulator adapted for mounting in a string of tubing.

H. T. Kennedy and P. L. Gassett, assrs to Gulf Research and Development Co. U.S.P. 2,411,793, 26.11.46. Treatment of Oil and Gas Wells.—A selective plugging method using a pumpable plastic.

W. H. Rupp and R. O. Wright, assrs to Standard Oil Development Co. U.S.P. 2,411,809, 26.11.46. Apparatus for Separating Fluids.—A plant designed for separating a substance in the vapour form from two immiscible liquid substances, and for then separating the two immiscible liquids. R. B. S.

Oilfield Development.

708. Completions Rate Drops But Exceeds 1945 Month. Anon. *Oil Wkly*, 23.9.46, **123** (4), 43.—An average of 546 wells/week were completed in August; the average for July was 575. Up to the end of August 16,937 wells had been completed in U.S.A. during 1946. 1441 of the 2729 wells completed in the 5 weeks of August found oil, and 269 found gas.

A table summarizes by States and districts the results of well completions in U.S.A. during August and during the first 8 months of 1946. G. D. H.

709. Gulf Coast Oilfields. J. S. Critz. *Oil Wkly*, 16.9.46, **123** (3), 110.—The Gulf Coast oilfields are arranged alphabetically under counties, also in alphabetical order, with brief notes on the location, discovery data, structure, producing formation, cumulative production, estimated reserves, number of wells, oil gravity, deepest well, oil outlet, and principal leaseholders. G. D. H.

710. Mexico Well Completions. Anon. *Oil Wkly*, 2.9.46, **123** (1), 10 (*International Section*).—6726 wells have been drilled for oil in Mexico, over 6200 being in the Tampico, Poza Rica, Golden Lane, and Tehuantepec areas, and only 150 being real wildcats. At present 7 wildcats are under way, two are in the Golden Lane area, and three in northeast Mexico.

Mexico's cumulative production is about 2,212,320,000 brl, nearly half having come from the Golden Lane. Poza Rica has given 236,200,000 brl, the Tampico–Panuco area 774,000,000 brl, and the Saline Basin only 137,600 brl. The Tamaulipas sector has provided 30,000,000,000 cu ft of gas.

Tables summarize drilling activity in 1946, and give the results yearly from 1932. G. D. H.

711. Bolivia Reveals Plans for Drilling; Trinidad Production Down, Mexico Up. Anon. *Oil Wkly*, 16.9.46, **123** (3), 80.—The YPFB in Bolivia plans to drill in the Guariri and Mandiapecua areas. In the first quarter of 1946 Bolivia produced 86,799 brl of crude from Camiri (30,010 brl), Bermejo (29,257 brl), and Sanandita (27,532 brl).

Trinidad produced 4,988,659 brl in the first quarter of 1946, and Ecuador 580,480 brl (653,183 brl in the second quarter). Mexico produced 2,219,956 brl from Poza Rica, Naranjos, and Panuco in June, Peru produced 1,006,388 brl of crude in May, and Alberta 653,806 brl in May. G. D. H.

712. Natural Gas Prospecting is Planned in Australia. Anon. *Oil Wkly*, 2.9.46, **123** (1), 8 (*International Section*).—An oil-prospecting licence has been applied for over an area in northeastern South Australia, on the New South Wales border, where natural gas with 70% of methane escapes from shallow holes. G. D. H.

713. Oil, the Rainbow of Hope in Saudi Arabia. H. Ozanne. *Oil Wkly*, 2.9.46, **123** (1), 3 (*International Section*).—The first oil discovery of Saudi Arabia was Damman in 1935, the reserves being estimated at 800,000,000 brl, with 28 wells currently giving 100,000 brl/day. Abqaiq has a proved area of 23,000 acres, with reserves estimated at 2,500,000,000 brl. This discovery was made in 1941. Five wells give about 70,000 brl/day. Qatif was discovered in 1945, and oil has also been found at Abu Hadriza.

The crude is asphaltic in each case. At Damman the best production comes from 4700 ft and at Abqaiq from 6500 to 7000 ft. Pipelines run to Ras Tanura, the refining and shipping centre.

A general description of the conditions is given, together with a summary of the reserves in the Middle East, the concession holders, and a list of the refineries. G. D. H.

714. Netherlands East Indies Oilfields. Anon. *Petrol. Engr*, Nov. 1946, **18** (2), 138.—The activities of the Japanese in the Royal Dutch Shell oilfields of the Netherlands East Indies and rehabilitation plans for these fields are briefly discussed. R. B. S.

Transport and Storage.

715. Completion of New Kirkuk–Haifa Line Expected in Spring of 1949. E. Aschner. *Oil Gas J.*, 1.3.47, **45** (43), 46.—The new 16-in pipelines to link Kirkuk with Haifa and Tripoli will parallel the existing 12-in system. Work was commenced at the end of 1945, 150 miles of line having already been laid. The project is expected to be complete by spring 1949. Some 180,000 tons of pipe will be required, which will be manual welded. The existing terminal facilities at Haifa and Tripoli will have to be extended, and the stabilizer plant at Kirkuk is being enlarged while additional wells are being drilled in the field. G. A. C.

716. Transfer-Line Pressure Drop. W. L. Nelson. *Oil Gas J.*, 22.2.47, **45** (22), 171.—No. 132 in the *Refiners' Notebook* series displays transfer-line pressure drop for two types of stock, one mainly gas oil, naphthas, and benzenes, the other mainly crude oil. The charts are available for 20%, 40%, 60%, and 80% vaporized in tower. Reference is also made to No. 128 in the series. G. A. C.

717. Welded Magnesium Tanks. R. J. Cross. *Aircr. Production*, March 1947, **9**, 97.—In the preceding parts the author described the design and construction of aircraft fuel and oil tanks fabricated in magnesium by Essex Aero, Ltd. In this final instalment he reviews in some detail the technique adopted in order to take full advantage of the highly favourable weldability characteristics of the material. I. G. B.

718. Transport and Storage Patents. H. G. Smith, T. L. Cantrell, and J. G. Peters, assrs to Gulf Oil Corpn. U.S.P. 2,408,102, 24.9.46. Oil Compositions.—A corrosion inhibitor consisting of an oil soluble trivalent metal salt of *N*-alkyl, alkylol ortho phthalmidic acid.

H. G. Smith, T. L. Cantrell, and J. G. Peters, assrs to Gulf Oil Corpn. U.S.P. 2,408,103, 24.9.46. Mineral Oil Composition.—A corrosion inhibitor consisting of an oil soluble divalent metal salt of *N*-alkyl, alkylol ortho phthalmidic acid.

H. A. Starret. U.S.P. 2,408,105, 24.9.46. Storage Tank.—A tank for the storage of fluids under pressure, which is immune from damage by shock waves and abrupt horizontal displacements of earth under any of the foot plates.

S. G. Thornbury, assr to Turco Products Inc. U.S.P. 2,408,155, 24.9.46. Composition for and Method of Cleaning and Coating Metal.—A compound consisting of a solution, containing water, phosphoric acid, aromatic petroleum solvent, butanol, and ethanol, for removing oil, grease, metal oxide, etc., from, and depositing a metallic phosphate coating on metal.

C. W. Brandon and G. M. Brandon. U.S.P. 2,408,505, 1.10.46. Receptacle for Fluids.—A tank for the transportation of volatile fluids.

P. A. Howard, assr of one half to C. A. Mathey and one half to C. B. Harter. U.S.P. 2,408,517, 1.10.46. Pipe-Cutting Apparatus.—A portable pipe-cutting mechanism.

J. H. Higgins. U.S.P. 2,408,538, 1.10.46. Liquid Storage Apparatus.—A storage tank of the floating roof variety.

J. H. Higgins. U.S.P. 2,408,539, 1.10.46. Fluid Storage Apparatus.—A variable volume storage tank for light fluids.

E. Hart, assr to A. O. Smith Corpn. U.S.P. 2,408,637, 1.10.46. Double Casing High Pressure Pump.—A high pressure pump of the centrifugal type.

C. H. Scott and P. H. Scott, assrs to The Safety Tank Truck Corpn. U.S.P. 2,409,071, 8.10.46. Venting and Discharge Valves for Tanks.—A vent and breather valve for tanks for storing volatile liquids.

S. T. Fisher, assr to Rogers Majestic Corpn. U.S.P. 2,409,975, 22.10.46. Pump Pressure Control System.—An apparatus for maintaining selected pump pressure differentials.

A. J. Granberg. U.S.P. 2,411,261, 19.11.46. A Fluid Metering Apparatus.

R. B. S.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

719. Multi-Stage Centrifugal Compressor Applications. T. R. Foster. *Oil Gas J.*, 8.2.47, **45** (40), 67.—A compressor is defined as a machine of radial design with two or more shrouded-type impellers in series, and discharge pressures from 50 to 500 p.s.i. Details are given in tabular form of a range of compressors with 2000 to 60,000 cu ft/min inlet volume, and maximum discharge pressures from 110 to 300 p.s.i. in semi-steel.

The economic upper limit of capacity of a centrifugal compressor may be fixed at about 120,000 cu ft/min, and 22,000 h.p., accommodated by utilizing the drive-through principle. The lower limit of capacity depends on the exit volume, and figures of 500 cu ft/min and 500 h.p. per case for exit volume, and 1500 cu ft/min for minimum inlet volume, may be used as a yard-stick. Most commercial applications fall in the 500 h.p. and higher capacity range, though horse-powers as low as 300 may prove economically feasible with direct steam-turbine drives, exhausting live steam to process.

Utility and driver costs vary greatly, but in general, centrifugal air compressors find greatest usage where fuel cost is low, *e.g.*, in blast-furnace blowers and fluid catalytic cracking units. Descriptions are given of a centrifugal refrigeration installation at Standard Oil Co., New Jersey, a mixed petroleum–hydrocarbon gas-compression installation in the Cities Service Refining Co. at Lake Charles, and centrifugal refrigeration machines using petroleum as the refrigerant at La Gloria plant, Texas.

Characteristics of the centrifugal compressor differ from those of the reciprocating compressor, but are similar to those of centrifugal pumps, except that (1) liquid pumps operate with equal pressure rise, constant volume, and constant temperature through each impeller, while uncooled gas pumps operate with variable pressure rise, volume, and temperature, (2) width of impellers decreases through the gas-pump, but may remain constant in the liquid pump. Both are independent of density as regards head, but pressure ratios for a number of impellers vary when different gases are compressed. Deviations from adiabatic seem to depend largely on specific heat ratios of gases.

For calculations of compression horse-power needs, an adiabatic base and Mollier diagrams are normally favoured; if an adiabatic base is employed for a centrifugal compressor a corrective factor must be used when gases of widely differing specific heat ratios are considered.

One set of rating curves is sufficient if sonic speed is not exceeded, and the centrifugal machine should be selected for a speed which will produce the required pressure differential with the minimum gravity gas the machine will be called on to handle. W. M. H.

720. Smokeless Burning of Refinery Vent Gases. A. K. Brumbaugh. *Oil Gas J.*, 22.2.47, **45** (42), 126.—A system for burning waste gases at the Torrance, California, refinery of the General Petroleum Corporation is described.

A venturi-type aspirating burner was designed in which *iso*-butane vapours were burned without smoke using a ratio of venturi throat to gas orifice area of 4 to 1. With gases containing up to 20% of unvaporized hydrocarbon this ratio had to be increased to 16 to 1. Stream pressure at the orifice was as low as ¼ p.s.i.g. without flame "popping back." Several burners of different sizes were employed, the installation handling 14,000,000 cu ft of gas per day, with an operating pressure range of ¼ to 4 p.s.i.g., the burners being automatically controlled to go into and out of service as gas pressure varied. An accumulator trapped liquid hydrocarbons to prevent them reaching the burners. G. A. C.

Distillation.

721. Preparation of Pure Paraffin Hydrocarbons by the Superfractionation of Synthetic Gasoline. L. Jacque, J. Givaudon, P. Schmitt, and R. Delion. *Rev. Inst. Franç. Pétrole*, 1946, **1**, 137–140.—A hydrogenated synthetic (Fischer) gasoline with d 0·688, b.p. 40–170° C and a content of aromatics + unsaturateds of less than ½% was fractionated in a laboratory 5 l still fitted with a 2½ m heated column. 1% cuts were taken and tested for n_D^{20} and an.pt. which, together with the b.p., were plotted against the vol. Examination of the graph shows that the composition of the gasoline is *n*-pentane 8–9%, *n*-hexane 22–23%, *n*-heptane 20–25%, *n*-octane 20–22%, and *n*-nonane 10–15%. Technical grades of *n*-pentane, *n*-hexane, *n*-heptane, and *n*-octane were prepared, the characteristics of these and of the pure compounds obtained from the technical grades by treatment with H_2SO_4 and re-distillation are given. It is suggested that compounds thus prepared would be of value in the laboratory, the *n*-hexane as a precipitant for asphaltic bodies, the *n*-heptane as a reference fuel for the CFR engine and, possibly, the *n*-pentane as a dewaxing solvent. V. B.

Cracking.

722. Naphthas from Fluid Catalyst Cracking. C. E. Starr, J. A. Tilton, and W. G. Hockberger. *Industr. Engng Chem.*, 1946, **39**, 195.—The compositions of naphthas derived from cracking with Fluid Catalyst vary within wide limits depending upon changes in operating conditions, types of catalyst employed, and feed stocks used. The compositions of nine naphthas are presented to illustrate the types of products obtained at low and high cracking temperatures with varying cracking severities, employing clay and synthetic catalysts with several paraffinic and naphthenic feed stocks. Composition data show that a number of valuable hydrocarbons, such as toluene, are present in the cracked naphthas to an extent which makes feasible their removal. The flexibility of the Fluid Catalyst cracking process permits operations for production of high quality fuels concurrent with a number of hydrocarbons that are individually valuable as raw materials for chemical manufacture. A. W.

723. More Gasoline—Less Coke—From New Catalytic-Cracker Design. Anon. *Oil Gas J.*, 1.3.47, **45** (43), 82.—A new type fluid catalytic-cracking pilot plant, designed by Universal Oil Products Co., is described.

A higher yield of gasoline is accomplished by better utilization of space in reactor and regenerator, and more efficient stripping of adsorbed light fractions from the spent catalyst. Amount of coke produced is substantially reduced. The plant has been operated on normal gas oils, and also on heavy gas oils with end points up to 1000° F, and has confirmed the expected increased gasoline and reduced coke yields. G. A. C.

Alkylation.

724. Monoalkylbenzenes by Vapour-Phase Alkylation with Silica–Alumina Catalyst. A. A. O'Kelly, J. Kellett, and J. Plucker. *Industr. Engng Chem.*, 1947, **39**, 154.—The monoalkylation of benzene with olefins of low molecular weight has been studied under laboratory conditions with batch and continuous apparatus, the catalysts being of the type used in commercial catalytic cracking. At elevated temperatures and relatively low pressures substantial yields of monoalkyl benzenes are obtained. The utilization of ethylene was found to be favoured by increased reaction time, increased temperature, and increased molar ratio of benzene to ethylene. Small amounts of polyethylbenzenes produced may be recycled in the charge stream to give increased yields of monoethylbenzene based on ethylene and benzene consumed. The catalyst indicates long life and sustained activity under the conditions used. A cyclic operation such as is used in catalytic cracking is adaptable to the production of monoethylbenzene in which air regeneration of the catalyst is carried out at temperatures in the same range as the reaction temperatures. A. W.

Special Processes.

725. Emersol Process. R. L. Demmerle. *Industr. Engng Chem.*, 1947, **39**, 126.—The preparation of commercial stearic and oleic acids is carried out by two principal methods; the continuous Emersol process, based on fractionation of the acids from a polar solvent, and the conventional batch method of mechanical pressing. The development of the former process led to the choice of 90% methanol in water as the most suitable solvent, consideration having been given to the factors of cost, type of crystal structure, refrigeration, stability, toxicity, and ease of removal. The commercial process, which is fully described, requires the introduction of a crystal promoter (usually a neutral fat) into the stream. Owing to the corrosive nature of methanol-fatty acid solutions, stainless steel or aluminium are necessary construction materials.

The demand for oleic acid now exceeds that for commercial stearic acid which generally contains 45 parts of stearic to 55 parts of palmitic. A. W.

726. Catarole Process. I. F. Kind. *Times Rev. Ind.*, Mar. 1947, 21.—Cat treatment at 1100–1250° F of a distillate with b.p. 225–550° F yields a product containing approximately equal amounts of liquid aromatics and gaseous olefins. The reactors can operate for 50–70 hr, after which the carbon on the cat is burnt off (8–10 hr) and the cycle recommences. The liquid product is fractionated to yield substantially pure aromatic compounds; solids, such as naphthalene, are further purified by recrystallization. The gaseous olefins produced are liquefied and separated by low temperature distillation. A list of products (with yields) is given. V. B.

Refining Patents.

727. Patents on Refining Processes and Products. H. C. Mayland, assr to U.O.P. Co. U.S.P. 2,404,393, 23.7.46. An alkylation process employing hydrogen fluoride as catalyst.

C. H. M. Roberts, assr to Petrolite Corpn. Ltd. U.S.P. 2,404,405, 23.7.46. Water dispersible substances contained in an oil of low water content are removed in a stage process involving emulsification with water and demulsification by means of an electric field.

C. C. Crawford and D. L. Yabroff, assrs to Shell Dev. Co. U.S.P. 2,404,436, 23.7.46. In the catalytic isomerization of methyl pentane to dimethylbutane about 1% hydroquinone is introduced into the reaction zone.

T. W. Evans, assr to Shell Dev. Co. U.S.P. 2,404,438, 23.7.46. The direct oxidation of ethylene to the oxide in the presence of a silver catalyst.

E. Lieber and A. F. Cashman, assrs to S.O. Dev. Co. U.S.P. 2,404,446, 23.7.46. An improved E.P. lubricant is obtained by multi-stage *iso*propyl alcohol extraction of a chlorinated paraffin alkali polysulphide reaction product.

I. G. Nixon, assr to Shell Dev. Co. U.S.P. 2,404,452, 23.7.46. Multi-cycle thermal cracking of a straight-run gasoline to produce aviation base.

F. E. Frey, assr to Phillips Petroleum Co. U.S.P. 2,404,483, 23.7.46. A combination isomerization-alkylation process to produce motor fuel from C_4 and C_5 hydrocarbons.

V. N. Ipatieff and G. S. Monroe, assrs to U.O.P. Co. U.S.P. 2,404,498, 23.7.46. Toluene is produced from benzene and methane in the presence of a metal catalyst or its oxide from the group in the atomic number range 26 to 29.

G. O. Morrison and M. M. Collins, assrs to Shawinigan Chemicals, Ltd. U.S.P. 2,404,519, 23.7.46. An aqueous emulsion of paraffin wax and polyvinyl acetate is used as a coating composition.

L. Schmerling and V. N. Ipatieff, assrs to U.O.P. Co. U.S.P. 2,404,536–8, 23.7.46. The catalytic alkylation of aromatic hydrocarbons.

E. A. Naragon, assr to The Texas Co. U.S.P. 2,404,591, 23.7.46. The aromatic hydrocarbons in an aromatic naphtha are isomerized by an aluminium halide–hydrocarbon complex catalyst.

C. Richker and B. Eastman, assrs to The Texas Co. U.S.P. 2,404,595, 23.7.46. A catalytic cracking process in which the charging stock is slightly cracked thermally before cathlytic conversion.

R. T. Sanderson, assr to The Texas Co. U.S.P. 2,404,599, 23.7.46. Alkyl-paraffins are obtained by the reaction between an aliphatic halide and an alkyl aluminium halide.

P. L. Veltman and L. W. Devaney, assrs to The Texas Co. U.S.P. 2,404,607, 23.7.46. Branched chain paraffins are obtained by the reaction between an alkyl halide and the reaction product of zinc and a *sec.* or *tert.* alkyl halide.

J. D. Grenko and L. R. Strawn, assrs to The Texas Co. U.S.P. 2,404,628, 23.7.46. A silica–alumina–zirconia catalyst is used to polymerize propylene to a polymer gasoline rich in aromatics.

R. T. Sanderson, assr to The Texas Co. U.S.P. 2,404,661, 23.7.46. 2 : 2 : 3-Trimethylbutane and 2 : 4-dimethylpentane are obtained when methyl aluminium chloride reacts with 2-chloro-2 : 3-dimethylbutane in solution in 2 : 3-dimethylbutane at − 58° to 32° F. Treatment of the mixed products with sulphuric acid at 70° to 125° F converts the 2 : 4-dimethylpentane to 2 : 3-dimethylpentane.

R. E. Burk and E. C. Hughes, assrs to S.O.C. Ohio. U.S.P. 2,404,788, 30.7.46. Olefins are polymerized with boron fluoride as catalyst, promoted by an oxygen-containing compound.

J. W. Latchum, Jr., and J. S. Connors, assrs to Phillips Petroleum Co. U.S.P. 2,404,854, 30.7.46. Separation of SO_2 from its mixture with gaseous hydrocarbons by the use of triethanolamine and regeneration of the latter.

P. R. Van Ess, F. J. Watson, and G. M. Whitney, assrs to Shell Dev. Co. U.S.P. 2,404,871, 30.7.46. A raffinate of a paraffinic lubricating oil is extracted with a mercury salt to produce a mercury salt sulphur compound complex from which the sulphur compounds are recovered.

W. N. Axe, assr to Phillips Petroleum Co. U.S.P. 2,404,897, 30.7.46. An alkylation process employing as catalyst a liquid addition compound of boron trifluoride and an acid of phosphorus.

W. H. Claussen and T. M. Powell, assrs to California Research Corpn. U.S.P. 2,404,902, 30.7.46. Pure aromatics are obtained from a selected narrow boiling fraction of a paraffin base petroleum by a multi-stage catalytic process, including reforming, dehydrogenation, and cyclization.

R. J. Patterson, assr to Phillips Petroleum Co. U.S.P. 2,404,923, 30.7.46. Catalytic isomerization of *n*-butane.

L. Schmerling and V. N. Ipatieff, assrs to U.O.P. Co. U.S.P. 2,404,927, 30.7.46. A multi-stage process to produce *iso*paraffins from an alkyl halide and a mono-olefin.

R. B. Thompson, assr to U.O.P. Co. U.S.P. 2,404,934, 30.7.46. Higher boiling alkylation products are contacted with *iso*butane in the presence of a catalyst to produce lower boiling hydrocarbons.

F. M. Stephens, assr to The Fluor Corpn. Ltd. U.S.P. 2,405,100, 30.7.46. An apparatus for dampening pulsations in a gas stream having pulsating flow created by a compressor. G. R. N.

Safety Precautions.

728. Characteristics and Uses of Fire Extinguishers. H. W. Boggess. *Oil Gas J.*, 8.2.47, **45** (40), 91.—A chart is given which lists the characteristics of various types of fire extinguishers under the main headings: method of operating; effective range of stream; liquid capacity; quantity and type of extinguishing agent produced; and whether effective for Class A fires (wood, textiles, rubbish), Class B (oils, greases), Class C (electrical machinery), or Class D (automobiles, trucks, etc.). The types of extinguisher discussed are tetrachloride, soda–acid, foam, carbon dioxide, and dry powder. W. M. H.

PRODUCTS.

Chemistry and Physics.

729. Purification, Purity, and Freezing Points of 7 Heptanes, 16 Octanes, 6 Pentenes, cyclo Pentene, and 7 C_9H_{12} Alkylbenzenes of the API-Standard and API-NBS Series. A. J. Streiff, E. T. Murphy, V. A. Sedlak, C. B. Willingham, and F. D. Rossini. *Bur. Stand. J. Res., Wash.*, Dec. 1946, **37** (6), 331.—Continuing the work on preparation of standard samples of hydrocarbons (*Bur. Stand. J. Res., Wash.*, 1946, **37**, 141), a further 37 hydrocarbons of the API-NBS series have been purified and their freezing points and purity determined.

Information on amounts, source, and purity of starting materials is given in tabular form.

Purification was by distillation, the experimental procedure being as described for 2-methyl-1-butene. The refractive index of each fraction of distillate was measured to $\pm$ 0·001 on Valentine refractometers, and accurate values of boiling points were obtained from distillation records. Freezing points of selected fractions were measured, using the apparatus and procedure described in a previous report (*Bur. Stand. J. Res., Wash.*, 1945, **35**, 335). Tables show details of distillation for each compound, and graphs give refractive index, boiling point, freezing point, and purity of hydrocarbon distillates as a function of volume. W. M. H.

730. Heat Content, Free-Energy Function, Entropy, and Heat Capacity of Ethylene, Propylene, and the Four Butenes to 1500° K. J. E. Kilpatrick and K. S. Pitzer. *Bur. Stand. J. Res., Wash.*, Sept. 1946, **37** (3), 163.—Using as a basis (1) moments of inertia, (2) vibrational frequencies, and (3) potential barriers restricting internal rotation, calculations have been made of the heat-content function, free-energy function, entropy, heat content and heat capacity, in the ideal gaseous state to 1500° K, for ethylene, propylene, 1-butene, *cis*-2-butene, *trans*-2-butene, and *iso*butene.

A comparison is made of these values with calorimetric data on heat capacity and entropy. Agreement is best for ethylene and poorest for *cis*-2-butene, possibly due to the complicated nature of the restricting potential in the latter compound.

W. M. H.

731. Phase Equilibria in Hydrocarbon Systems. H. H. Reamer, K. J. Korpi, B. H. Sage, and W. N. Lacey. *Industr. Engng Chem.*, 1947, **39**, 206.—The volumetric behaviour of four experimental mixtures of methane and *n*-butane, approximately evenly spaced as to mole fraction, was explored at seven temperatures from 100° to 460° F and at pressures from near 400 to 10,000 p.s.i., to supplement previous measurements for this system. The experimental data, interpolated to even values of pressure, are presented in tabular form as molal volumes and compressibility factors. Diagrams illustrating the behaviour are included, and the new data are compared with previously reported results. A. W.

732. Emulsion Polymerization of Diene Hydrocarbons. H. W. Starkweather, P. O. Bare, A. S. Carter, F. B. Hill, Jr., V. R. Hurka, C. J. Mighton, P. A. Sanders, H. W. Walker, and M. A. Youker. *Industr. Engng Chem.*, 1947, **39**, 210.—The results of an exploratory study of the emulsion polymerization of conjugated diene hydrocarbons to yield rubber-like polymers are summarized. Such polymerization variables are discussed as purity of reagents, nature and amount of a second monomer, emulsifying agents, alkali concentration, catalysts, catalyst activators, modifying agents, temperature, and yield. An investigation of the influence of some 214 different compounds co-polymerized with butadiene reveals wide differences in the polymerization rate and properties of the co-polymers, depending upon the structure of the second monomer. Such vinyl compounds as methacrylic acid esters, methyl vinyl ketone, dimethyl vinyl ethynyl carbinol give with butadiene potentially useful co-polymers. Convenient forms of equipment for the small scale preparation, compounding and testing of new types of elastomers are described. A. W.

733. Peroxidation in Relation to Olefinic Structure. E. H. Farmer. *India Rubber J.*, 1947, **112**, 119.—The autoxidation of olefins, comprising peroxidation and peroxide breakdown, is reviewed with reference to (1) the mechanism and position of peroxidation, (2) its effect on molecular linking, (3) the stabilities of peroxide groups in relation to molecular structure, (4) the mechanism of breakdown and the influence of light, heat, or catalysts, and (5) the manner of utilization of " active " oxygen to give new oxygeno-groups or chain scission. C. N. T.

734. Thermochemistry of Carbon : Valence States, Heats of Sublimation and Energies of Linkage. L. H. Long and R. G. W. Norrish. *Proc. roy. Soc.*, 1946, **186**, 337.—The controversy which at present exists between the figures 125 and 170 K.-cal/g atom for the latent heat of sublimation of carbon into mono-atomic vapour is discussed. A scheme is suggested which reconciles points hitherto in apparent conflict which takes into account the energy associated with tetravalent state of carbon with special reference between bond energies and energies of dissociation. It has thus been possible to correlate previous experimental data associated with the thermo-chemistry of carbon. H. C. T.

735. Thermodynamic Properties of Hydrocarbons. II. Numerical Data and Examples. N. Tcherkezoff. *Rev. Inst. Franç. Pétrole*, 1946, **1**, 152–160.—(See Abstracts 432/47 and 433/47.) This instalment is devoted to a tabulation of recorded values of the heat of formation (@ 25° C) and of the entropy for a number of hydrocarbons. Two examples of the calculation of entropy from calorimetric data are given. V. B.

736. Degradation Activity of Fischer Synthesis Catalysts and the Participation of Methane in this Synthesis. O. Gœpfert. *Comptes Rendus*, 1947, **224**, 340.—The formation of long-chain hydrocarbons indicates that the Fischer synthesis catalysts are able to bring about the union of methyl and methylene radicles, formed by the reduction of carbon monoxide. The former aspect of the process can be examined, in an inverse manner, by studying the fission of C–C bonds in the ethane–hydrogen system, which results in the formation of methane. An analytical and kinetic study of this system shows that hydrogen, when present in excess, reacts to a less extent than ethane. The decomposition of the latter by a hydrogenation reaction to form methane is accompanied by its decomposition to give methane and carbon without hydrogenation. The latter product is subsequently converted into methane by hydrogenation at a much lower rate. It is considered that either mode of reaction of ethane proceeds in the adsorbed state, and intermediate steps involving methyl and methylene radicles are postulated.

On the basis of these results, the participation of methane in the Fischer synthesis is accounted for by the ability of Fischer catalysts to decompose adsorbed methane into methyl and methylene radicles which are then assimilated into the reaction products. G. H. B.

737. Development of Activity in Fischer Synthesis Catalysts. M. Perrin. *Comptes Rendus*, 1947, **224**, 342.—At 190° C freshly reduced catalyst forms solely methane and the normal reaction giving higher hydrocarbons sets in only after extended operation.

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At 225° C, however, methane only is formed. This behaviour has been ascribed to the hydrogenating activity possessed by unused catalyst. The addition of methane to the synthesis gas represses the initial abnormal reaction and the substitution of an equal proportion of nitrogen has the same effect. The duration of the abnormal reaction with fresh catalyst can also be shortened by a temporary reduction in the reaction temperature to 175° or by decreasing the linear velocity of the reactants. Using fresh catalyst at 190° with the synthesis gas at normal pressure, the first layers of catalyst to meet the reactants attain a temperature of not less than 240° and methane alone is formed. When the activity of the catalyst has been modified, its temperature falls to 200–210° and the normal products are formed. This self-heating of the catalyst is responsible for the initial abnormal reaction, and if it is limited by, *e.g.*, a reduction in the partial pressure or charge rate of the reactants or a temporary reduction in bulk catalyst temperature, the normal reaction predominates from the start. G. H. B.

Analysis and Testing.

738. Molecular Weights in Practice and Theory. II. Theory. A. V. Brancker. *Petroleum*, 1947, **10**, 4.—A general theoretical discussion, dealing with the theory of molecular weight determinations as based on the law of dilute solutions.
K. C. G. K.

739. Simple Cyclic Falling-Film Molecular Still. J. K. Taylor. *Bur. Stand. J. Res., Wash.*, Sept. 1946, **37** (3), 173.—The chief difficulty encountered in the use of falling-film stills is the tendency to approach bulk distillation rather than surface evaporation, due to unequal distribution of the distilling liquid on the evaporator surface. The apparatus described here overcomes this problem by the use of a central vertical evaporator, on to which the distilling liquid is pumped from a reservoir through an annular orifice which ensures a persistently uniform film around the evaporator surface. The shortness of the column makes for increased efficiency. The charge which may be used ranges from a minimum of 10 mls to 1 l. W. M. H.

740. Laboratory Testing of Emulsified Oil. L. T. Monson. *Petrol. Engr*, Nov. 1946, **18** (2), 67.—The centrifuge methods of testing emulsified oil and the use of resolving agents in the determination of water content and of dry oil gravity are described.
R. B. S.

741. Viscosity by Different Instruments—High Range. W. L. Nelson. *Oil Gas J.*, 8.2.47, **45** (40), 99.—A table gives viscosity figures which are equivalent to kinematic viscosity, from forty-one to seven hundred centistokes, for the following instruments: Saybolt Universal at 100° F, 130° F, 210° F; Saybolt Furol; Redwood Admiralty No. 2; Engler; and Redwood Standard No. 1. W. M. H.

742. Viscosity Temperature Coefficients of Oils. H. K. Whalley and S. J. Leach. *Petroleum*, 1947, **10**, 2.—A critical examination of the V.I. as compared with the portraying of the viscosity temperature characteristics of lubricating oils by a curve relating the logarithm of viscosity and the reciprocal of the absolute temperature. The temperature dependence of viscosity may be expressed by the equation:

$$\log \nu = (E_\nu/RT) + C, \textit{ i.e.,} \; a \log \nu/aT = -E_\nu/RT^2$$
$$\text{or } a \log \nu/a(1/T) = E_\nu/R$$

where ν is the viscosity in centistokes, T is the temperature in ° K, E_ν is the activation energy of viscous flow and R is the gas constant. The term E_ν/R is the temperature coefficient of viscosity, which is the slope of the lines obtained by plotting $\log \nu$ against $1/T$. This latter method has certain advantages deriving from its theoretical basis and range of applicability. On the other hand V.I. is purely empirical, depending on arbitrarily chosen standard oils. In routine problems of oil technology it is true that the use of V.I. provides the basis of comparison for the properties of conventional oils, but in research work the more fundamental significance of the viscosity coefficient justifies its being preferred. K. C. G. K.

743. Engine Testing of Fuels and Lubricants. (3) 1. Fuel Consumption and Power Output. P. H. Moore. *Petroleum*, 1947, **10**, 18.—For both fuel consumption and power output determinations it is essential to employ an accurate method of measuring the quantity of fuel supplied to the engine. An inverted pipette type of fuel-measuring apparatus and a modification of Hoffert and Claxton's carburetter are described. As regards power units, it is necessary to employ a single-cylinder unit for spark ignition engines, since the single-induction manifold for all cylinders of the multicylinder type causes irregularities in the air–fuel ratio received by individual cylinders. A single-cylinder unit is not necessary for testing diesel fuels, since in the diesel engine there is an independent feed to each cylinder. K. C. G. K.

744. Detection of Light Hydrocarbons in Drilling Muds. E. Vellinger. *Rev. Inst. Franç. Pétrole*, 1946, **1**, 141–144.—An apparatus is described for determining the light hydrocarbon content of drilling muds, whereby the gas is withdrawn from a known volume of mud, by means of vacuum, and burnt on the surface of a heated platinum wire in a special apparatus. The hydrocarbon content of the gas is measured by the contraction in volume after combustion, the apparatus being calibrated with known mixtures. A determination can be performed by semi-skilled labour in 10 mins, thus permitting of the examination of strata during drilling. V. B.

Gas.

745. Natural Gas Stored in Buried Pipe at 2240 lb. C. R. Claxton, M. G. Markle, and D. V. Meilert. *Oil Gas J.*, 1.3.47, **45** (43), 60.—A natural-gas-storage installation placed in service by the Public Service Co., Illinois, is described.

The installation consists of 50 lengths of steel pipe, each 40 ft long and 24 in. in diameter, in each of which 25,000 cu ft of natural gas is stored at 2240 p.s.i., total capacity 1,250,000 cu ft.

Gas is supplied through a high-pressure distribution feeder main from 30 miles away, and distributed in the Kankakee area through a central low-pressure natural-gas system. The storage facilities described were installed to take care of a temporary failure of the feeder main.

The compressibility factor at 2240 p.s.i. is of such a magnitude as to increase the storage capacity by more than 40% over that of a perfect gas.

The operating pressure of 2240 p.s.i. conforms to the A.S.M.E.–A.S.A. code for pressure piping. The pipe weighs 500 lb per 40-ft length, and has a minimum wall thickness of 0·448 in. All underground piping is coated and has cathodic protection.

Additional equipment consists of a 3-stage compressor capacity 6000 cu ft/hr at 40 p.s.i.g. for filling the special pipe regulators for withdrawing the gas, and a boiler and heat exchanger for heating the gas prior to pressure reduction.

Operating experience has been satisfactory, and being underground, facilities are not subject to storm damage, atmospheric conditions, or aviation hazard. G. A. C.

746. Natural-Gas Reserves. E. De Golyer. *Oil Gas J.*, 4.5.46, **44** (52), 80.—See Abstract No. 1369 [1946].

Gas Oil and Fuel Oils.

747. Boiler Oil for Diesel Engines. Anon. *Motor Ship*, 1947, **28** (326), 485.—Further details are given of the performance of the Anglo-Saxon Petroleum Co.'s motor tanker *Auricula*, burning Ordoil of 1250 sec Redwood I at 100° F. Conditions of fuel valve, exhaust valve, reduction valve, piston crown, lubricating oil purifier, and piston-cooling water-system are reported on. I. G. B.

Lubricants.

748. Solvent Refining and Dewaxing of Lubricating Oil. W. E. Skelton. *Oil Gas J.*, 22.2.47, **45** (42), 137.—A general review of solvent refining and dewaxing is given. The process produces a refined oil freed of components susceptible to oxidation, sludge formation, and carbon deposition, and amenable to further improvement by the in-

corporation of additives. The V.I. of the oil is improved, thus the oil is not as extremely viscous at low or as thin at high temperatures as the non-solvent refined product. The dewaxing process removes the wax and provides an oil which will remain fluid at low temperatures. The process is flexible and is applicable to a wide range of lubricating oil stocks.

Two flow diagrams are given. G. A. C.

749. Continuum Theory of Rheological Phenomena. K. Weissenberg. *Nature*, 1947, **159**, 310.—To develop this theory, the material is considered to be taken through a cycle from the initial (ground) state by imposing mechanical action to an energized state; then allowing a return to a ground state (not necessarily the initial state) by removing the force. The material is said to be *stable* if it can be taken repeatedly through the same cycle, and *general* or *special* if the recoverable strain (*i.e.* the difference between the ground states) is finite or zero respectively.

The experimental arrangement is that of a McMichael viscometer the internal cylinder of which is of special design. Using saponified oils, rubber solutions, starch, etc., the results indicate that the stress force comprises the shear–stress components and a pull along the lines of flow, the latter and the recoverable strain being finite or zero together.

An empirical law relating the three mutually perpendicular components of stress and recoverable strain to a generalized modulus of elasticity containing parameters of temperature and time has been replaced by an assumption, involving the similarity of mutually perpendicular traction forces in the energized and ground states, from which the empirical law can be derived. This assumption has been proved for materials isotropic in all ground states (1) in all classes of rheological states for certain orientations of planes; (2) for all possible orientations of planes in certain rheological states. H. C. E.

750. Lubricating Oil Tests. Anon. *Gas Oil Pwr*, 1947, **42**, 53.—Laboratory tests and specifications for engine lubricating oils include: determination of specific gravity, colour, flash-point, fire-point, viscosity, pour-point, demulsibility, carbon residue, neutralization and saponification values, ash content, asphaltenes, diluent and water content, and chemical stability. Whilst the Ramsbottam or Conradson tests for carbon residue do indicate the tendency of the oil to oxidize, chemical stability, measured in the Underwood test by spraying hot oil on to a split crankpin-bearing bush, is more significant. At the end of the 36 hr Underwood test, when the oil resembles in some respects a used automotive oil, it is examined for neutralization and saponification values, viscosity, and asphaltenes. Corrosion is estimated by weighing the bearing bush after cleaning. H. C. E.

751. Strontium Greases Satisfactory for Severe Service Applications. H. J. Worth and L. W. McClennan. *Oil Gas J.*, 1.3.47, **45** (43), 74.—The preparation, properties, and uses of complex strontium-base greases are described.

Compounding materials include strontium hydrate, mineral oils, and the usual soap stocks, and equipment used is the conventional steam-jacketed type fitted with agitators. Several types of commercial strontium greases have been marketed for special industrial purposes.

Various additives have been incorporated as in other greases. Either buttery or fibrous type strontium greases are produced, the properties are determined by type of oil or liquid vehicle used, and by characteristics of the saponifiable materials from which the soap has been made. The greases are prepared as anhydrous products, and are reversible over wide temperature limits. They resist the emulsifying and disintegrating effects of water, and are considerably resistant to the leaching action of light hydrocarbons.

Strontium greases are resistant to oxidation or break-down on exposure to elevated temperature, and the relatively superior rust-protective action is useful against moisture or salt spray corrosion.

Applications include lubrication of bearings in an atmosphere of sulphur and solvent vapour, as in the rubber and tyre industries, and for bearing points on aircraft where high temperatures are involved.

Tables show composition of representative strontium-base greases prepared by

various procedures, and results of salt spray tests on steel panels coated with various greases. G. A. C.

752. Chemical Treatment for Wear Reduction. Anon. *Oil Engine & Gas Turbine*, 1947, **14**, 339.—Phosphate coating of any parts in an I.C. engine subjected to sliding friction has been found effective for preventing wear. Iron–manganese is the type most frequently used.

During treatment, a surface coating of insoluble complex iron–manganese phosphates is found on the iron surface to a total thickness of between 0·0002 and 0·0003 in. This is essentially a bedding-in layer, the wear on running-in being slightly greater than the coating thickness.

The advantage of this surface treatment is that oil is retained by the coating under conditions where it would otherwise be removed by excessive pressure on the high spots. The phosphate coating has also good corrosion-resisting properties, and has anti-welding properties in the absence of lubrication. In addition, it is possible to use a lower viscosity oil than with untreated surfaces, thus avoiding the use of special or more expensive lubricants.

Phosphate treatment can reduce " fretting " corrosion, which may occur when closely fitting surfaces are subjected to vibration, and has been found on the whole to be the most satisfactory process for postponing this type of corrosion. In some cases cadmium or tin coating has been found to be superior. C. D. B.

753. Improving Lubricating Oil Consumption, by " Five-Fifty ". *Oil Engine & Gas Turbine*, 1947, **14**, 341.—In experiments to reduce the oil consumption of certain diesel engines conducted by an operator with the co-operation of the manufacturer, it was found that after cleaning the engines under test at the end of about 1800 hr running, fitting new piston-rings, and grinding-in valves, an improvement in lubricating oil consumption resulted for a short time. The consumption, however, increased at more or less clearly defined intervals.

Modification to the original piston-ring arrangement (3 ordinary compression rings and 2 scraper rings) by replacing No. 1 (top) compression ring with Triple Seal ring resulted in an improvement of oil consumption of over 400%.

To prevent rise in oil consumption during operation, the scraper-ring slots and piston-drain holes had to be kept free of carbon. By increasing the rate of flow and by regular cleaning with perfectly dry compressed air the Streamline filter fitted to each engine was made more effective.

Keeping the soot content of the oil below 0·1% resulted in a reduction of oil consumption to one-third of its original value. C. D. B.

754. Oilspread and Lubrication (2). A. H. Stewart. *Petroleum*, 1947, **10**, 11.—Some of the conditions influencing the phenomenon of oil-spread are discussed. Mixtures of mineral oils with 1% of fatty acid show continuous sliding with the coefficient of friction only slightly larger than that of the fatty acid component. This suggests that the bulk of the mineral oil is squeezed out (the sliding member was a loaded ball) so that the adsorbed film providing the boundary conditions consists mainly of fatty acid. Furthermore, results seem to show that the fatty acid is desorbed as the temperature rises. Investigation of dry film lubricants (by Hughes and Whittingham) revealed that a colloidal graphite film had the lowest coefficient of friction and continuous motion was evident, when one of the metal surfaces was graphited. However, graphite is better known as an additive to lubricating oil. Tests have shown the value of the graphite film, once it is formed, in this connection. Graphited oils are also valuable, like certain oils with fatty acid additives, in avoiding seizure in an emergency when boundary conditions are established. They have the further advantage that the graphite film is unaffected by any temperature or load likely to occur in practice. Such boundary conditions are only a temporary phase, however, pending the restoration of fluid-film lubrication and it has been shown experimentally that the graphite film facilitates oil-spread. This applies also in the case of chromium-plated and stainless steel with a mirror finish. K. C. G. K.

755. Steam Turbine Lubrication Problems and their Solutions. 3 (2). Cooling Function of the Oil. A. Wolf. *Petroleum*, 1947, **10**, 13.—The temperatures of both the

oil and the water entering and leaving a cooler should be logged daily so that any change in cooler efficiency will reveal itself. To guard against damage from vibration, the cooler should be built separated from the turbine. The oil pressure while passing through the cooler should be higher at all points than the water pressure, so that any leakage occurring will be relatively harmless, *i.e.*, oil into water. Leakage should always be tested for "hot," as hot oil has a much greater capacity for percolating through even extremely minute leaks. As regards the effect of leakage of water into the oil, a continuous entry of considerable amounts of water is sometimes thought to be even beneficial, provided that the water settling out in the oil reservoir is automatically discharged or drawn off at regular intervals. However, the accidental washing of the oil due to water leakage in the cooler is very detrimental, because the water droplets in the oil may generate sufficient steam on coming in contact with the hot journal to bring about local rupture of the oil film and consequent damage of the babbitt due to frictional heat. K. C. G. K.

Derived Chemical Products.

756. Vinyl Alkyl Ethers. C. E. Schildknecht, A. O. Zoss, and C. McKinley. *Industr. Engng Chem.*, 1947, **39**, 180.—The literature related to simple unsubstituted vinyl alkyl ethers is reviewed. New data are presented on the purification and properties of the vinyl alkyl ether monomers. Special attention is given to vinyl methyl, vinyl *n*-butyl, and vinyl *iso*butyl ethers, which have been made available for development purposes in this country by application of the Reppe synthesis. Correct physical data on these materials are of special interest, both because the monomers are comparatively unstable and because their behaviour in polymerization is greatly influenced by certain types of impurities. Chemical reactions of the vinyl alkyl ethers include addition to the double bond, hydrolysis, and polymerization. Some preliminary work on the polymerization of vinyl alkyl ethers is described together with observations on several commercial polyvinyl alkyl ethers from abroad. A. W.

Miscellaneous Products.

757. Evaluation of Lignite Tar. A. Gosselin. *Rev. Inst. Franç. Pétrole*, 1946, **1**, 145–151.—The investigation was carried out on a tar (d_{15}, 1·026, 80% volatile at 360° C, phenol content 41%) from the low temperature (450° C) carbonization of lignite from Bouches-du-Rhône. Physical characteristics and chemical analysis of the tar are given. Owing to the highly reactive nature of the tar, it cannot be treated like a pet product and hydrogenation is the best approach. This was carried out using a mixed catalyst based on molybdenum sulphide and using a 3 : 1-hydrogen–nitrogen mixture. Processing (at 400 atm and 470° C) for maximum gasoline production yielded 86% (wt) with b.p. 55–186° C and O.N. (Motor) of 75. An alternative is to hydrogenate with a view to production of solvents and lubricating oils. For this purpose the tar was separated by distillation (at 20 mm. and cutting at 220° C) into two equal fractions by volume. The light portion on hydrogenation (400 atm, 355° C) yields a gasoline/W.S. cut, a highly aromatic solvent fraction, a heavier cut (280–320° C) suitable as a plasticiser and a phenol fraction. The heavier portion of the tar is hydrogenated (400 atm, 380° C) to give a spindle oil and a medium viscosity (11·2 cs at 98·2° C) lubricating oil having moderate V.I. (64), good p.pt (− 7° C) and good oxidation characteristics. The overall yield of products on thus hydrogenating the tar in two portions is 86·9% (32% of gasoline and solvent, 9·7% of light phenols, 14·2% of spindle oil, 25·7% of medium lubricating oil and 5·3% of wax). It is concluded that hydrogenation is the only feasible method for utilizing such tars and that it could also be applied to indigenous (French) bitumens. V. B.

Engines and Automotive Equipment.

758. Research for the Motor Industry. Anon. *Gas Oil Pwr*, 1947, **42**, 51.—The Motor Industry Research Association is carrying out work on the following topics of engine design and operation: (1) The effect of piston ring design on engine operation;

(2) Petrol injection; (3) Investigation of the wear of journals running in combination with copper–lead bearings; (4) Correlation between fatigue strength of crankshafts and the properties of the component materials.

Subjects on which work is proposed include correlation of cetane number of diesel fuels with smoke and noise, cold starting, and engine fouling. H. C. E.

759. Power Installations. F. M. Owner. *J. R. aero Soc.*, 1947, **51** (434), 71.—The lecture formed part of a discussion on Engineering Problems of Future Aircraft and in its reported form gives the views of a member of the Bristol Aeroplane Co. on future power installations. Propulsion systems are tabulated and the paper deals with the following main items: classification of aircraft requirements; classification of power plants; possible power installations; installation requirements; general trend of development; conclusion on engineering problems. I. G. B.

760. Nene Installation. Anon. *Flight*, 1947, **51**, 217.—Details given of Rolls-Royce gas turbine power units in a Lancastrian. Many features of jet installation, such as the mounting structure, remote auxiliary drive arrangements, and the jet pipe relief duct, are shown for the first time. The tubular mounting is attached to the face of the front spar, part of the load being transferred to the rear spar by an interspar structure. The adapted fuel system includes two auxiliary kerosine tanks which have been added on the fuselage; the original No. 2 petrol tanks are retained for the inboard Merlins. I. G. B.

761. New Polar Diesel Engine. Anon. *Motor Ship*, 1947, **28**, (326), 477.—The Atlas Diesel Co. of Stockholm have in course of development a new type of marine diesel engine, of larger cylinder size than hitherto built and designed for ship propulsion either through gearing or with diesel drive. The first engine of the type to be installed in a ship is a 7-cyl set. It is of 2-cycle, single-acting design:

Cylinder diameter	500 mm
Piston stroke	700 mm
R.P.M.	250/155
B.H.P.	2800/2050
M.E.P.	5·23 kg/cm²
Piston speed	5·83 in/sec.

I. G. B.

MISCELLANEOUS.

762. Applications of Liquefied Petroleum Gas. A. G. Arand. *Petroleum*, 1947, **10**, 3.—The gas is neither pure butane nor propane, but a mixture blended to suit the industrial uses demanded under prevailing climatic conditions. The portability of plant operated by liquid petroleum opens up a variety of possible uses in industry and these are discussed. Burners and ranges using liquefied petroleum gas can be used for easily controlled room heating of various types. Apart from such uses, mixtures of protane and butane have certain advantages as motor fuel, for they do not strip lubricating oil from the cylinder walls and crank cases. K. C. G. K.

763. Argentine Petroleum Industry (3). A. Landoni and A. Zanetta. *Petroleum*, 1947, **10**, 14.—The third and final instalment of the series deals with the Argentine petroleum industry petroleum statistics, the development of the National Petroleum Company and future prospects. K. C. G. K.

764. Economics of Colombian Oil Industry. E. Ospina-Racines. *World Petrol*, 1947, **18** (2), 37.—In 1946 revenues from petroleum (29·2 U.S. cents/brl) comprised 6% of Colombia's total revenues. The varying ratio of oil industry income tax to royalties, within the last decade, is discussed. Further revenue from oil can be obtained only by increasing output and not by additional taxation. Other recent economic data (yield per employee, capital investment, exports and production) relating to Colombia's

oil industry are briefly summarized. Greater government encouragement would rectify the Colombian oil industries' present uneconomic status. V. B.

765. Conversion of French Locomotives to Oil-Burning. Anon., *Engineer*, 1947, 183, 171.—620 steam locomotives in France are to be equipped to burn oil instead of coal. The "141-R" class has been chosen because of its relatively large fire-box. As ancillary equipment, 100 storage tanks, each of 1000 cu m capacity, with suitable pumping facilities, are to be installed. The estimated oil consumption for 1947 is 600,000 tons, increasing to 1,000,000 tons in future years. A. C.

BOOK REVIEW.

Manual of Uniforming Accounting Practices for the Oil Well Drilling Contractor. Pp. 116 + xviii. **Costing Guide.** Pp. 108 + viii. Dallas, Texas: American Association of Oilwell Drilling Contractors, 1945.

The objective of the two companion manuals is not stated, but it is presumed that they aim at the standardization of oil-well drilling accounting in order that comparisons of costs, etc., can be made on sound bases.

The "Manual of Uniform Accounting" describes with great clarity and in detail the principles upon which all good accounting practices are built up.

Suggestions are made for standard forms of financial statements, but it is appreciated that these will require modifications to suit particular circumstances and needs.

It is in the chapters on uniform cost accounting that the value of the "Manual" mainly rests. As the authors state, it is essential that allocations of expenses should be made to the same accounts consistently, and that the names of various expenses should indicate the same thing to all and should not be changed without the knowledge and agreement of all.

It is recommended that all costs be divided primarily into seven major divisions: (1) labour and supervision; (2) supplies; (3) maintenance and repairs; (4) ordinary operating expense; (5) other operating expense; (6) depreciation; (7) overhead. Forms for presenting divisions and subdivisions of the above accounts are shown, and a noteworthy point is that size and file perforation standards are provided for.

The various methods of dealing with depreciation are fully discussed.

A method of subdividing the seven major accounts to afford greater detail is given and this is made up in such a way that great flexibility is possible.

In the summary the authors stress the importance of the time factor in drilling cost control.

The "Costing Guide" is, in effect, an alphabetically arranged index permitting any article or service to be correctly allocated in the uniform accounting procedure.

The uniform practice described is distinctly elaborate, but it can be reduced to suit individual requirements. Its adoption in full could not be justified by small concerns since much simpler procedures would be as satisfactory for the purposes of cost control and maintenance of efficiency.

Its adoption will be most beneficial in the U.S.A., where it is most common to carry out well-drilling through the contract system. E. C. S.

BOOKS RECEIVED.

Materialui po Litologii (Contributions to Lithology). Moscow, 1946. Pp. 88. Price: 10 rubles.

This is issue No. 3 (7) (New Series) of "Contributions to the Knowledge of the Geology of the U.S.S.R." It is published by the Natural History Society of Moscow and includes papers dealing with the genesis of bauxite, the structure of certain coal deposits and with carbonate minerals in saline lagoons. V. B.

A.S.T.M. Standards on Petroleum Products and Lubricants. Pp. 615 + xii. Philadelphia, Pa.: American Society for Testing Materials, 1946. $4. Obtainable also from The Institute of Petroleum, £1 1s. post free.

This latest annual edition of the A.S.T.M. Standards covering petroleum products and lubricants contains eighty-five more pages than its immediate predecessor and gives in their latest approved form ninety-nine test methods, twenty-eight specifications, and six lists of definitions. Numerous changes are detailed in the report of Committee D-2, the appendixes to which cover methods of test for (1) sulphated residue of lubricating oils; (2) phosphorus in organic materials; (3) aromatic hydrocarbons in mixtures with naphthenes and paraffins by silica gel adsorption.

1946 Book of A.S.T.M. Standards. Part I—A : Ferrous Metals. Pp. 1181 + xxiv. **Part I—B : Non-Ferrous Metals.** Pp. 917 + xxiv. **Part II : Non-Metallic Materials—Constructional.** Pp. 1762 + xxxviii. Philadelphia, Pa. : American Society for Testing Materials, 1946.

Normally a triennial publication, exhaustion of the 1944 Edition has necessitated issue with only a two-year interval. Opportunity has also been taken to publish in five parts instead of three to avoid bulky and inconvenient volumes.

Flowing Gold. The Romance of Oil. John J. Floherty. Philadelphia : J. B. Lippincott Co., 1945. Pp. 256. $2.50.

A popular story of the oil industry.

Reports on Fuel Economy Since 1939. London : World Power Conference, 1946.

Further reports in the series prepared for this year's Fuel Economy Conference are :

Irish Report. Pp. 8. 6*d*.
French Report. Pp. 28. 1*s*. 6*d*. Includes a chapter on petroleum products.

Technical Missions to Germany.

Further official reports have been received as follows :

B.I.O.S. REPORTS.

380. The Bentheim Gas Field (History and Present Status as a Source of Natural Gas). Pp. 19.
446.* Reitbrook Oilfield. Repressuring using Flue Gas. Pp. 18.
513.* Notes on the Organization of the German Petroleum Industry during the War. Pp. 14.
636.* Mineralölwerke F. Harmsen, Kiel, Germany. Lubricants. Pp. 11.
637.* Olex Deutsche Benzin und Petroleum Gesellschaft. Fuels and Distribution. Pp. 13.
638.* Deutsche Erdöl A.G., Hamburg, Germany. Crude Oil and Products. Pp. 13.
690. Prevention of Atmospheric Pollution by Noxious or Offensive Gases, Fumes, or Dusts. Pp. 55.
734. German Brown Coal Industry. Pp. 42.
771.* Specifications and Testing of Oils, Fuels, and Lubricants in Germany. Pp. 236.
875. Phthalic Anhydride Plant at I.G. Farben. A.G., Verdingen, Germany. Pp. 8.
928. German General Rubber Goods Industry. Part II. Pp. 275.
935.* I.G. Farben., Ludwigshafen am Rhein. Manufacture of Phthalic Anhydride. Pp. 9.
937. Dr. F. Raschig G.m.b.H., Ludwigshafen am Rhein. Tar Products. Pp. 8.
967.* Deutsche Vacuum Oel A.G., Hamburg. Fuels and Lubricants. Pp. 159.
1117. The Benzin-Benzol Verband, Bochum, and the German Benzole Industry. Pp. 31.

F.I.A.T. REPORTS.

917.* Manufacture of 2-Ethyl-anthraquinone at the I.G. Farben. Plant in Ludwigshafen. Pp. 11.
935. The Production of Higher Vinyl Esters, Ludwigshafen. Pp. 7.

J.I.O.A. REPORTS.

70.* Some Notes from the Interview of Mr. Berendt of Blohm and Voss on the Blohm and Voss System of Oil Burning in Marine Boilers and an Ignition Starter for Cold Boiler Starting. Pp. 3.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	196 A
Geophysics and Geochemical Prospecting	200 A
Drilling	200 A
Production	203 A
Oilfield Development	210 A
TRANSPORT AND STORAGE ...	213 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	214 A
Cracking	216 A
Polymerization	217 A
Chemical and Physical Refining	217 A
Special Processes	217 A
Refining Patents	218 A
PRODUCTS.	
Chemistry and Physics ...	229 A
Analysis and Testing	231 A
Gas	232 A
Engine Fuels	232 A
Gas Oil and Fuel Oils ...	233 A
Lubricants	234 A
Bitumen, Asphalt and Tar ...	236 A
Special Hydrocarbon Products	237 A
Derived Chemical Products ...	237 A
Coal, Shale and Peat	237 A
Miscellaneous Products ...	238 A
ENGINES AND AUTOMOTIVE EQUIPMENT	239 A
MISCELLANEOUS	241 A
BOOK REVIEW	243 A
BOOKS RECEIVED	243 A

AUTHOR INDEX.

The numbers refer to Abstract Numbers.

Adams, E., 830
Aires, R. S., 876
Akins, D. W., Jr., 801
Alden, R. C., 876
Alden, R. G., 879
Alexander, P., 876
Amyx, J. W., 820
Anderson, H. H., 855
Anderson, J., 876
Anderson, J. A., Jr., 876
Appell, F., 874
D'Arcy, N. A., Jr., 796
Armstrong, E. R., 788
Arnold, C., 876
Arnold, J. C., 876
Arveson, M. H., 876
Atkins, G. T., Jr., 876
Atwell, H. V., 876
Ayers, G. W., 876

Badertscher, D. E., 876
Bagy, D. G., 904
Bahlke, W. H., 876
Bailey, G. C., 876
Bailey, W. A., J., 876
Bailie, J. C., 876
Barrington, R., 914
Barron, J. M., 876
Barton, D. M., 876
Bauer, G. G., 816, 831, 921
Bax, A. R., 876
Beach, F. K., 805, 806
Belchets, A., 876
Bell, R. T., 876
Benedectis De, A., 876
Bennett, G. A., 858
Bentley, F. J. L., 876
Berg, C. H. O., 876
Berger, H. G., 876
Bevis, W. A., 914
Bielkowicz, P., 882
Bigelow, W. C., 899
Birch, S. F., 876
Bishop, R. B., 876
Blanding, F. H., 906
Bloch, H. S., 876
Bloomquist, W. C., 815
Blott, J. F. T., 876
Bludworth, J. E., 907
Bohmer, C. W., Jr., 876
Bolt, J. A., 876
Boucher, H. G., 876
Bradley, W. E., 876
Brancker, A. V., 885
Brink, K. C., Ven., 876
Brook, K., 914
Brooks, J. W., 876
Bullard, B. F., 876
Burgess, J. E., 876
Burgin, J., 876
Burk, R. E., 876
Burns, W. W., 782, 833

Camp, E. Q., 876
Campbell, J. M., 876
Cantrell, C. D., Jr., 876
Cantrell, T. L., 876
Carmody, D. R., 876
Carney, S. C., 876
Carpenter, M. T., 876
Cashman, A. F., 876
Cass, O. W., 876
Cattaneo, A. G., 876
Cheney, H. A., 876
Chenicek, J. A., 876
Clark, C. R., 876
Clarke, L. A., 876
Clason, C. E., 797
Codet, H. G., 876
Cole, R. M., 876
Collins, C. P., 795
Collis, C. B., 876
Connolly, G. C., 876
Creelman, G. D., 876
Crowther, J. F., 876
Cubberley, R. H., 876
Cummings, G. H., 876

Danner, A. V., 876
Daric, G., 853
Davis, L. F., 812
Day, R. B., 876
Day, R. J., 808
Deering, R. F., 876
Dent, F. J., 876
Diamond, H., 876
Dight, S. R., 930
Dickinson, J. T., 876
Dickinson, N. L., 876
Disney, R. W., 767
Doumani, T. F., 876
Drennan, H. E., 876
Duncan, G. W., 876
Durrum, E. L., 876

Eckel, J. E., 798
Egloff, G., 893
Evans, A. G., 877
Evans, T. W., 876
Evering, B. L., 876

Fagin, K. M., 787, 791, 822
Fairweather, H. G. C., 876
Fawcett, E. W. M., 876
Fenske, M. R., 876
Ferris, S. W., 876
Fidler, F. A., 876
Fife, J. G., 876
Flood, E. L., 876
Forney, W. E., 876
Foster, A. L., 876
Fratis, J. B., 876
Frey, F. E., 876

Galstaun, L. S., 876
Garner, F. H., 890
Garrison, A. D., 876
Gebauer, A. H., 876
Gerhold, C. G., 876
Goodson, L. B., 876
Gordon, R. R., 889
Gorin, E., 876
Greenburg, R. B., 876
Greene, F. C., 773
Greenfelder, B. S., 876
Gregory, J. N., 900
Gresham, W. F., 876
Griesinger, W. K., 876
Groote de, M., 876
Gross, H. H., 876
Gutzeit, C. L., 876

Habeshaw, J., 876
Hagerbaumer, W. A., 869
Hall, L. G., 876
Hall, H. J., 876
Harford, W. E., 876
Haskell, N. B., 876
Hawthorne, W. P., 876
Heinemann, H., 876
Henderson, L. M., 876
Hene, E., 876
Henry, R. W., 876
Hepp, H. J., 876
Hersberger, A. B., 896
Hill, R. H., 876
Hineline, H. D., 876
Hock, R. L., 809
Horeczy, J. T., 876
Horne, 856
Hornley, L. H., 876
Horton, A. W., 876
Howes, D. A., 866
Hoyte, W. N., 876
Huff, L. C., 876
Huffman, H. C., 876
Hughes, E. C., 876
Hughes, R. V., 818, 826
Hughes, T. P., 876
Hyde, H. Y., 876

Ipatieff, V. N., 876
Iverson, J. O., 876
Ives, G. O., 777

Japes, D. H., 876
Jenkins, G. I., 876
Jodell, G. E., 876
Johnson, H. L., 876
Johnson, E. R., 876

Johansson, S. C., 876

Kastrop, J. E., 790
Kearly, K. K., 876
Keating, G. H., 876
Keiser, B., 876
Kellett, III, J., 876
Kelly, A. A., 876
Kelly, W. A., 772
Kennedy, H. T., 813
Kielhorn, H. F., 876
Kind, F., 873
King, R. H., 774
Kirkpatrick, J. B., 876
Kollen, M. H., 876
Kothny, G. L., 789, 794
Kruse W. E., 876
Kuhl, P. E., 876

Lake, G. R., 876
LaLande, Jr., W. A., 876
Lane, H. W., 929
Larsen, C. M., 888
Laughlin, K. C., 876
Lauterback, R. E., 867
Lee, E. C., 876
Lee, R., 869
Lenn, N. F., 876
Lethersich, W., 897
Lewis, R. H., 903
Lieber, E., 876
Linn, C. B., 876
Lockett, J. R., 768
Loeb, H. D., 876
Lowe, R. E., 876
Lugaresi, A., 883
Luten, D. B., Jr., 876
Lynch, C. S., 876

McAllister, S. H., 876
McCleary, R. F., 876
McNab, J. G., 876
Maass, R., 867
Macfadyen, W. A., 837
Mahan, J. S., 876
Mackay, J. S., 876
Mann, G. L., 871
Marancik, J. C., 876
Mardel, E., 876
Marley, H. R., 876
Marschner, R. F., 876
Martin, E. J., 876
Martin, H. Z., 876
Martin, W. F., 811
Marusic, M. M., 876
Matuszak, M. P., 876
Mavity, J. M., 876
May, D. T., 823
May, R. L., 876
Meadow, J. R., 876
Meenert, R. N., 876
Mekler, L. A., 876
Meldrum, R. F., 876
Menzie, D. E., 807
Merta, V., 876
Miller, K. T., 800
Miller, L. E., 824
Mohr, A. C., 876
Moignard, L. A., 876
Monson, L. T., 804
Montgomery, J. V., 876
Moore, P. H., 884
Moorman, A. R., 876
Morey, G. H., 876
Morgan, F., 800
Morgan, J. D., 876
Morris, J. R., 876
Morris, R. C., 876
Morse, R. A., 825
Morway, A. J., 876
Mullins, B. P., 892
Musher, S., 876
Muskat, M., 800

Neilson, R. F., 807
Nelson, W. L., 861, 864, 896
Nelson, W. R., 862, 863
Newton, E. P., 876
Newton, R. H., 876
Nicholson, E. W. S., 876
Nickle, C. O., 775
Nissan, A. H., 890
Noble, F. G., 876
Noone, M., 854
Norman, H. S., 769, 770
Nugent, L. E., Jr., 766
Nutting, H. S., 876
Nyswander, C. W., 876

Oakley, E. H., 876
Ocon, C. L., 876
Ocon, E. A., 876
O'Kelly, A. A., 876
d'Ouville, E. L., 876

Parker, R. L., Jr., 876
Patterson, J. A., 876
Peck, E. B., 876
Peel, D. H. P., 876
Penn, W. S., 909
Perrine, J. H., 876
Peters, J. G., 876
Pevere, E. F., 876
Pezzaglia, P., 876
Phinney, J. A., 870
Pickett, D. L., 899
Pines, H., 876
Pinfold, E. S., 850
Plucker, J., 876
Poore, J. N., 815
Powell, H., 889
Putz, T. J., 918

Quartel De, H. J. M. W., 799

Ramage, A. S., 876
Ray, G. C., 876
Read, D., Jr., 876
Redcay, A. K., 876
Reed, P., 857
Reenhardt, F. E., 876
Reid, J. C., 894
Riecke, S. C., 876
Ringgenberg, H., 895
Ringham, C. R., 876
Roberts, G., 870
Roberts, E. N., 876
Robertson, A. E., 876
Robinson, R., 878
Robotham, W. A., 913
Roethell, B. E., 906
Rogers, D. T., 876
Ross, W. E., 876
Rout, A. E., 876
Rubin, L. C., 876

Sachenen, A. N., 876
Scheeline, H. W., 876
Schindler, H., 876
Schmerling, L., 876
Schmitt, A. C., 876
Schou, H., 876
Schulze, W. A., 876
Shankland, R. V., 876
Shephardson, R. M., 876
Shokal, E. C., 876
Short, E. H., 891
Siecke, P., 876
Skinner, D. A., 876
Small, W. N., 835
Smallwood, H. M., 876
Smith, A. D., 876
Smith, E. A., 876
Smith, G. W., 772
Smith, H. G., 876
Smith, K. W., 817
Smith, M. A., 876
Snow, R. D., 876
Snuggs, J. F., 868
Solomen, E., 876
Somers, J. J., 876
Spink, J. A., 900
Sprung, M. M., 876
Steiner, H., 876
Stover, W. A., 876
Struth, H. J., 829
Stuart, A. H., 898
Stuart, R. W., 793
Tadayyon, J., 889
Tcherkezoff, N., 880
Terwilliger, P. L., 819
Teter, J. W., 876
Thacker, C. M., 876
Thomas, C. L., 876
Thomson, R. C., 929
Thompson, R. B., 876
Thornes, L. S., 876
Tongberg, C. O., 876
Tooke, J. W., 879

Underwood, A. J. V., 876
Upham, J. D., 876

Veltman, P. L., 876
Verter, F. L. De, 876
Viland, C. K., 876
Voorhees, A., Jr., 876

Wadley, E. F., 876
Walsh, D. C., Jr., 876
Walter, R. B., 810
Watkins, C. H., 876
Webb, G. M., 876, 886
Webber, W. C., 876
Webber, W. O., 876
Weber, G., 931
Weinberger, M. A., 877
Weiser, H. B., 876
Welty, A. B., Jr., 876
Whincup, S., 876
Wickenden, L., 876
Wilford, A. T., 901
Williams, N., 771
Williams, P. H., 876
Wilson, G. M., 792
Winning, C., 876
Wisenbaker, J. D., 803
Wilf, A., 902
Wolk, I. L., 876
Wood, G. F., 890
Woodward, R. E., 876
Work, R. H., 876
Work, R. W., 876
Wright, D. L., 876
Wrigley, J. B., 814
Wyman, J. B., 876

Yeager, F. W., 876
Young, D. W., 876
Yuster, S. T., 807, 817, 819, 820, 825

Zaks, S. L., 802
Zimmer, J. C., 876
Zisman, W. A., 899
Zwicky, M., 895

Oilfield Exploration and Exploitation.

Geology.

766. Aerial Photographs in Structural Mapping of Sedimentary Formations. L. E. Nugent, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 478–494.—The proper use of aerial photographs where the geologic–photographic relationships are favourable, can undoubtedly produce satisfactory structural maps more rapidly and economically than any other method.

It has been suggested that in areas of little relief the operator of the aerial plotting instrument should draw the complete map, leaving the topographer only the jobs of field inspection and completing the contours.

Factors controlling the use of aerial photographs in structural mapping are discussed, and the anticipated horizontal and vertical photogrammetric precision is indicated.

E. N. T.

767. Trimetrogon Aerial Photography. R. W. Disney. *Oil Gas J.*, 19.10.46, **45** (24), 112–115.—In trimetrogon aerial photography three cameras are arranged to take one vertical and two oblique photographs simultaneously, at intervals along the line of flight, thereby covering a strip about 35 ml wide in a single run. The inner edges of the obliques overlap the margins of the vertical photograph. Vertical photographs would call for parallel flight lines 3–4 ml apart, compared with 5–10 times this width for the trimetrogon method. The trimetrogon method may require only about one-fifth the number needed with conventional verticals, but there is some loss in accuracy of interpretation. The trimetrogon method is cheaper and quicker than the vertical method. Trimetrogon photographs can be employed to construct large-scale maps from conventional small-scale maps.

The geological interpretation of the oblique photographs is rather more difficult than for the verticals. G. D. H.

768. Development of Structures in Basin Areas of North-Eastern United States. J. R. Lockett. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 429–446.—The Upper Mississippi Valley had, until recently, been studied only in isolated areas, and consequently no general picture of it had been obtained.

As a result of recent work, however, it is suggested that, contrary to former belief, an area comprising Ohio, the southern peninsula of Michigan, Indiana, Illinois, and northern Kentucky should be considered as a distinct structural province. The major and minor features in this province are related, but not as the result of the uplift of either; and there is no evidence that direct lateral pressure caused by the Appalachian orogeny had any appreciable influence on structure west of the Pittsburgh–Huntington basin.

With the aid of stratigraphic evidence, it is suggested that the dominant positive structural features are underlain by the crystalline cores of pre-Cambrian mountain ranges, and that during the whole of the Palæozoic era the principal movement was the continued subsidence of the basins in between.

The effect of the weight of these basins and their drag on the positive features is considered. The drops of various regions have been investigated, and it is concluded that the Cincinnati Arch crest has dropped 2000 ft since the Trenton was deposited, while in the Logansport sag any individual bed is more than 1000 ft below its elevation at each end of the Kankakee–Wabash trend.

The directions of the lines of weakness and their extent are postulated, and the development of structures formed in the overlying sediments in the Pittsburgh–Huntington, Michigan, and Illinois basins is discussed.

Evidence is brought forward to support the opinion that the province in question was shielded from direct pressure by the formation of the Pittsburgh–Huntington basin; in fact, certain of the forces involved are the reverse of compressional, and the features are shown to be mainly the results of differential subsidence.

An experiment is described by which the general pattern of lines of weakness in this area was reproduced on a small scale.

With such an understanding of the history of this structural province, the direction of known trends can be explained. Further work remains to be done on this new basis. E. N. T.

769. California's No. 1 Proven Reserve. H. S. Norman. *Oil Gas J.*, 7.9.46, **45** (18), 70.—45 producers have been completed in Zone 237 and the related conglomerate-schist zones at Wilmington. Currently this zone is producing about 25,000 brl/day.

The field's cumulative production is about 305,000,000 brl, the production late in July averaging 121,180 brl/day. Remaining reserves at the end of June were placed at 329,971,000 brl.

The field has six major faults, and complexities in sand distribution and structure. The extent of the Zone 237 under the Long Beach Harbour waters is not known.

The sand of Zone 237 is coarse and interbedded with shale. Permeability ranges 50–1000 md.

Production at Wilmington was first found in 1925 when seeking to extend the Torrance field, but not until 1932 was commercial production established. Full-scale development began late in 1936. About 1500 wells have been drilled, most of them

producing from the Tar, Ranger, and Terminal pays. The gas/oil ratio has risen to about 1100 cu ft/brl. The original gas content of the reservoirs above Zone 237 is estimated to have been 708,553,510,000 cu ft, and 415,500,000,000 cu ft remain.
G. D. H.

770. Production Report—Salt Creek Pool. H. S. Norman. *Oil Gas J.*, 19.10.46, **45** (24), 136.—The Salt Creek pool of Kern County, California, lies 1½ ml northwest of the Cymric pool. It may be a plunging nose complicated by faults. The proven area is 100 acres, and a recovery of 800 brl/acre/ft is estimated. There is an effective water-drive. Production is from the Carneros (Miocene) and at depths of about 2800–3000 ft. Sand permeabilities of 1000–2500 md have been measured, and producing gas/oil ratios of 125–150 cu ft/brl. Porosities range 30–35%. Currently the production is 1700 brl/day.
G. D. H.

771. Drilling at Mattoon. N. Williams. *Oil Gas J.*, 7.9.46, **45** (18), 80.—The Mattoon field of Coles County, Illinois, is about 9 ml long and ½–2 ml wide. Its oil reserve is estimated to be about 25,000,000 brl. Oil was discovered in 1939, but most development has taken place since mid-1945. The initial discovery was in the Cypress sand at 1875 ft. Some 313 wells have been drilled and 3,125,000 brl of oil has been produced. Production is obtained principally from the Cypress, Aux Vases, and Rosiclare. A few McClosky completions have been made. Strong gas flows and oil shows have been found in the Devonian. Sand conditions are variable.

Wells cost $15,000–$17,000 and involve no special problems. When two sands are produced they are not isolated. The crude is 38–40° A.P.I. The Cypress sand alone has a gas cap, and this covers less than 100 acres.
G. D. H.

772. Stratigraphy and Structure of Traverse Group in Afton-Onaway Area, Michigan. W. A. Kelly and G. Wendell Smith. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 447–469.—The formations of the Traverse of middle Devonian age which outcrop in the Afton–Onaway area (about 50 sq ml in Cheboygan and west-central Presque Isle counties) are described, and the structural relationships determined from their distribution.

The scattered outcrops are correlated with the better-known sections bordering on the Lake Huron and Lake Michigan areas. The Bell Shale, Rockport Quarry limestone, Ferron Point formation, Genshaw formation, Newton Creek limestone, Koehler limestone, Gravel Point formation, and the Beebe School formation are described. They are correlated mainly on the evidence of the fossilized fauna they contain, but also with the help of sharp lithologic breaks between other subdivisions which are characterized by a uniform composition and texture between their upper and lower boundaries.

The fact that the Traverse in the area described is considerably less thick than the Traverse sections of the east and west is attributed to diastrophism.

A structural contour map based on these stratigraphic divisions is attached. It shows, from east to west, the Pigeon anticline, a small structural nose between two minor synclines, and the Black Lake anticline bordered on the east by the Onaway syncline.
E. N. T.

773. Missouri: Its Oil and Gas Possibilities. F. C. Greene. *Oil Wkly*, 9.9.46, **123** (2), 34.—At the end of 1945 Missouri had 43 active oil wells and 36 gas wells. Production is from the Mississippian, Devonian, and Pennsylvanian. In the southern part of the State there are shallow Pennsylvanian wells with small outputs. Some of them have gone to the pre-Cambrian. Asphaltic residues have been found in the Mississippian in some places. Structures are apparently gentle and some pools are due to lensing. In the northwestern co..ties potential producing horizons occur in the Pennsylvanian, Mississippian, and Devonian. Glacial drift obscures many of the surface structures. There is an unconformity between the Pennsylvanian and Mississippian. These two features call for well-planned exploratory work.

In southeast Missouri Cretaceous rests unconformably on Ordovician and Cambrian. Geophysical work should be used to discover structures in this area.

Maps show the structure and sites of pools in northwestern Missouri, and a generalized section is included.
G. D. H.

774. Sedimentation in Permian Castile Sea. R. H. King. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 470–477.—The Permian Castile formation, having a relatively simple stratigraphy and well-defined boundaries, is a favourable starting point for a study of precipitated marine sediments. It varies in thickness from 1300 ft at the north end of the basin to 2000 ft at the south end, and consists mainly of " banded " or laminated anhydrite, though it also contains some small calcite lenses and some halite. It was laid down in the steep-walled Delaware Basin in southeastern New Mexico and western Texas. The Permian Sea which withdrew to this basin from a wider area at the end of Guadalupe time, was connected with the open sea through a shallow channel throughout Castile time.

It is generally accepted that the anhydrite of which most of the Castile formation consists is a chemical precipitate rather than a detrital deposit.

It is suggested that in the Delaware Basin the water was differentiated into an underlying concentrated brine, below wave base and ponded behind the barrier, and a surface layer of lesser density. In Castile time the more soluble salts passed out of the basin in the reflux of the underlying brine to the open sea; but the less soluble salts were precipitated.

The preponderance of anhydrite over the halite indicates a scarcity of terrestrial water, and is adduced to support the suggestion that either the top of the barrier was below wave base, or the barrier was permeable.

The calcium sulphate was deposited as anhydrite rather than gypsum on account of the salinity of the Castile Sea. The characteristic lamination of the anhydrite can be ascribed to seasonal variations in temperature.

The theory of reflux is a modification of Ochsenius' bar theory adapted to explain the deposition of the Castile sediments. E. N. T.

775. Western Canada Mid-year Report. C. O. Nickle. *Oil Wkly*, 5.8.46, **122** (10), 3.—54 wildcats, 11 successful, were completed in 1945. 37 wildcats have been completed in the first half of 1946. The proven area of the Viking–Kinsella gas reserve has been extended from 100,000 acres to 250,000 acres. The reserve may be 1,000,000,000,000 cu ft in the Viking sand. On the southeast edge of the gas reserve oil has been found. 60 ml to the southeast gas has been found in the Viking sand and oil in the Lower Cretaceous. The Lloydminster field has been expanded. A flowing well has been completed in the " Taber " sand (Lower Cretaceous) of the West Taber field.

Gas and slight porosity have been found in two slices of Madison limestone on the Brazeau anticline. The upper reservoir gave 500 Mcf and a show of oil with a substantial increase in gas flow on acidization. A further test is expected on this structure.

A Lower Cretaceous gas well has been completed in the Alberta syncline.

The Lloydminster field has been extended into Saskatchewan.

Tables list the Alberta wildcat completions for the first half of 1946 and give the oil production by fields. G. D. H.

776. Depth Record for South America Established Second Time This Year. Anon. *Oil Wkly*, 19.8.46, **122** (12), 31.—Curazao A-2 east of the Cabimas area fields had reached a depth of 13,446 ft early in August. Previously South America's deepest well was Bajada 1 (13,206 ft) in Ecuador. Curazao A-2 is still in the Eocene and has not yet had shows of seemingly commercial importance. G. D. H.

777. Colombian Exploratory Activity. G. O. Ives. *Oil Wkly*, 5.8.46, **122** (10), 12 (International Section).—Concessions totalling 4,931,382 acres are held by 6 active oil companies. In July 14 wildcats were drilling. Velasquez 1 in the Upper Magdalena valley is expected to open a new field. Costa Rica 1 in the Lower Valley has had some shows. La Salena 1 in the Las Monas area has also had shows. Chorrea Manteca 4 is preparing to test sands between 5611 ft and 6795 ft, having been drilled to 7046 ft in the basement.

Some 15 geophysical crews are at work. G. D. H.

778. Tests on Wildcat Which May Open Colombia Field. Anon. *Oil Wkly*, 19.8.46, **122** (12), 31.—Velasquez 1 entered granite at 8450 ft after penetrating about 100 ft of conglomerate immediately at the base of the Tertiary. Oil stains have been noted in the conglomerate and shows in sands cored in the lower part of the Tertiary. The best

shows were in the depth range 6400–8265 ft. A drill-stem test at 7254–7274 ft gave 15 stands of 30-gravity oil. G. D. H.

779. Spring Hill 3 Test Commenced by Chile. Anon. *Oil Wkly*, 26.8.46, **122** (13), 29.—Spring Hill 3 has been commenced on Isla Grande, 6 ml from the north end of the Straits of Magellan. Spring Hill 2 was completed dry at over 10,000 ft. Spring Hill 1 has never been fully completed, but latest guesses give its potential as 1500 brl/day. In the foothills to the northwest Pocket 1 is being drilled. G. D. H.

780. Completion Due Soon on Third Chilean Test. Anon. *Oil Gas J.*, 21.9.46, **45** (20), 163.—The third test on the Spring Hill structure is reported to have passed a depth of 7000 ft. It lies ¼-ml southwest of the discovery well. G. D. H.

781. Dutch Coevorden Field Now Producing 630 brl Daily. Anon. *Oil Gas J.*, 12.10.46, **45** (23), 61.—At Coevorden the Cretaceous lies at depths of about 1050 ft. About 630 brl/day is being obtained from a sand which averages 75–85 ft in thickness. Richer structures may occur across the border in Germany. G. D. H.

782. "Cradle of Civilization" Scene of Oil Search by Standard of Egypt. W. W. Burns. *Oil Gas J.*, 19.10.46, **45** (24), 95.—The Abu Roash well, some 10 ml west of Cairo, reached granite at 6250 ft. The Sudr wildcat, 40 ml south of Suez, on test gave 22° A.P.I. oil at the rate of 275 brl/day. A second well is being drilled.

El Khabra on the Sinai–Palestine border has reached 5890 ft and is in limestone, possibly of Jurassic age. Wadi-Baba on the Sinai side of the Gulf of Suez has reached 4548 ft, being in schist. A test is to be drilled at Ras Abu Rudeis, 9 km due west.

Currently Egyptian Standard has three geological parties, one gravity meter, and one seismic party at work.

The Western Desert Province has Oligocene, Miocene, and Pliocene beds commonly covered by superficial deposits which render geophysical work necessary. G. D. H.

Geophysics and Geochemical Prospecting.

783. Magnolia Testing Offshore Formations in the Gulf. Anon. *World Petrol.*, 1947, **18** (3), 60–61.—Magnolia have leased 5 blocks of submarine land from Louisiana, which is to receive 12½% of all oil taken and rent for the properties. Two off-shore ventures, including the whole organization and equipment, are described and illustrated. F. S. A.

784. Marine Exploration Develops New Techniques. Anon. *World Petrol.*, 1947, **18** (3), 57–59.—Systematic efforts are being made to determine the presence of submarine oil—especially in the Gulf Coast and Bahamas areas. In addition to the air-borne magnetometer, radar is used to locate positions for gravimetric tests. Diving chambers are used when possible in making gravimetric observations on the ocean floor. Two types are described, together with a number of ingenious ways in which craft of various kinds have been adapted to serve as geophysical bases. The text is illustrated by photographs. F. S. A.

785. Russians Use Bacteriological Analysis in Oil Exploration. Anon. *Oil Gas J.*, 7.9.47, **45** (18), 60.—The presence of hydrocarbon bacteria in near-surface rocks and soil has been utilized to locate an important gasfield at a depth of 628 ft near Mikhailovsky. The bacteria utilize minute quantities of hydrocarbons seeping from the gas accumulation at depth. G. D. H.

Drilling.

786. New Heavy Duty Power Rig. Anon. *Petrol. Times*, 4.1.47, **51**, 22.—The operation of a new British heavy-duty drilling rig capable of drilling to over 16,000 ft is briefly described. R. B. S.

787. Diesel Electric Barge Rig Designed to Drill 15,000 ft Wells. K. M. Fagin. *Petrol. Engr*, Jan., 1947, **18** (4), 49.—The construction and operation of a 2100-h.p. barge rig drilling in the coastal area of Lousiana is described. R. B. S.

788. Seadrome-Type Offshore Foundation for Continental Shelf Operations. E. R. Armstrong. *Oil Wkly*, 27.1.47, **124** (9), 41.—A rig structure which is designed for sea work in depths from 20 to 200 ft and which provides a floating, portable, and seaworthy structure for the drilling operations is described. The principles of designing such structures are very briefly outlined. It is essential that a portable rig be buoyant so that it can be readily moved from one location to another. In an offshore area, such as the Gulf of Mexico, where gales frequently reach hurricane force, whipping up short, high seas of tremendous energy, seaworthiness, and all that the word implies, is of even greater importance than portability. Therefore, to insure the desired portability and seaworthiness in this type of rig, it must not only float, but must be of such strength and form that it will be unaffected by wind and waves while on service duty. This means that when the rig is floating it must have ample stability, capable of meeting all sea conditions without danger and be equally safe when resting on the ocean bottom. Further, it would appear desirable that when serving as a drilling base, the structural weight resting on the bottom should be variable within wide limits. In many locations the safe load-carrying capacity of the ocean floor may vary considerably with the result that if the loading value could not be reduced, settlement would result —with possible disastrous effects on the drilling operation. It is also necessary to be able selectively to adjust the vertical trim, or levelness, of the drilling rig to compensate for possible irregularities in the ocean bottom. Means must also be provided to make reflotation of the rig easy and reliable and to insure ample structural stability during all phases of the operation.

Experiments with a model show an openwork structure with a multiple buoyancy system very suitable for marine drilling. A. H. N.

789. Controlled Directional Drilling of Wells. Part 2. G. L. Kothny. *Oil Wkly*, 27.1.47, **124** (9), 36.—The use of the whipstock, knuckle joint, spudding bits, and of non-magnetic drill collars in orienting a bit for directional drilling is described and illustrated. The use of controlled directional drilling in different American fields is reviewed. The illegitimate application of controlled directional drilling in California was halted in 1935 when the Superior Court of the State of California, in and for the County of Los Angeles, in the case of Alphonso E. Bell Corporation, *et al*, Plaintiffs, *v.* Belleview Oil Syndicate, *et al*, Defendants, decided that one who drills an oil well on his own land and permits the drill to drift into the lands of another, and with knowledge of the bottom puts the well on production, is liable for trespass and for conversion of the oil taken from the other's land. And further, that the fact that at the time of the drilling of such wells, the facilities and applicances had not been perfected and the knowledge of drilling had not advanced so that directional drilling was an art and the drilling of straight holes was unknown, did not justify the operator in drilling into strange lands at a distance of 1500 ft from the surface location and placing his well on production at that point, notwithstanding the pool produced from extended into the lands of the drilling party. This court decision gave quite an impetus to direction drilling and well surveying.

Cylinder drilling refers to the drilling of a well, the course of which is described, and which must be held within a radius of 25 ft of this predetermined course. The course is plotted so as to avoid conflict with existing wells and to provide correct bottom hole spacing. Cylinder drilling is now widely used in California. Over 200 deflected wells with a footage of over 1 million ft have been drilled in the Huntington Beach area. About 40% of these are cylinder drilled holes. The angles of inclination vary from 30° to 65° off the vertical. More than 25 million brls of oil have been produced from directionally drilled wells in this field.

The use of relief wells to kill cratered wells is described. A. H. N.

790. Drilling Rigs are Going to Sea. J. E. Kastrop. *Oil Wkly*, 3.2.47, **124** (10), 33.—Several methods proposed for marine drilling—one of which visualized to be used down to 600 ft of water—are described. Gross designed sloping leg-derricks on skids and vertical derricks; Kirby's tower utilizes an octagonal structure; Robert proposes the use of prefabricated sections which can form a tower; Shrewsbury patented a floating column of 40-ft dia. × 200 ft long. Other designers propose ships, converted Landing Ships, Tanks (L.S.T.) fairlead and seadrome-type platform. Certain of these methods have been tested on model scales. A. H. N.

791. F.M. Radio Communication Aids Operation of Rigs. K. M. Fagin. *Petrol. Engr*, Dec. 1946, **18** (3), 174.—Small portable frequency modulation transmitters and receivers developed during the war can provide an efficient radio-telephone communication system up to a range of 60 ml. The installation and operation of such a system to assist in drilling operations is discussed, and detailed circuit diagrams are presented.
R. B. S.

792. Quick Remedial Work Solves Difficult Blow-out Problem. G. M. Wilson. *Oil Wkly*, 20.1.47, **124** (8), 34.—Several months after completing a well it was noticed that the pressure in the annular space between the 11¾-in. surface string and the 7-in oil string was increasing considerably In a short time the pressure caused the surface equipment to fail; the crew stripped off the whole of the surface equipment and let the well flow. With the well then flowing uncontrolled, but clear of surface obstructions, it was decided to construct a special packer in the form of an inverted liner hanger having inside and outside diameters that would enable it to be lowered down over the 7-in casing, the latter string still being at the top of the well and inside the 11¾-in surface string. Such a seal, it was believed, would effectively shut off the flow through the annulus. An 8¾-in nipple, 10 ft long, with linear hanger on the lower end, and a 9-in, 6000-lb test-gate valve on the upper end was to be made up. Two 3-in horizontal valves were to be positioned a short distance below the 9-in gate to provide communication to the well after the large gate had been closed. It was believed that this assembly would position the packer about 12 ft below the base plate, a point believed below the ruptured portion of the surface string. The execution of these plans is described.
A. H. N.

793. Diamond Coring at Rangely, Colorado. R. W. Stuart. *Petrol. Engr*, Jan. 1947, **18** (4), 43.—The use of diamond tools for coring the Weber sand in the Rangely field of N.W. Colorado is described. Pressure coring methods were used in some runs.
R. B. S.

794. Controlled Directional Drilling of Wells. Part 1. G. L. Kothny. *Oil Wkly*, 20.1.47, **124** (8), 30.—The application of and principal factors for successful controlled directional drilling are described in this part of the paper. The applications are generally: (*a*) For drilling new wells which cannot be located directly above the desired completion point; (*b*) for redrilling wells where a correction in the natural course of the well is desirable or necessary. Under the first application come wells located beneath the ocean, lakes, or river bottoms, wells located under the piercement type salt dome overhangs, wells located around objectionable locations, where the surface topography makes drilling at an angle from a lower location preferable to deeper drilling through a hill, relief wells for bringing under control burning or blown-out wells, wells drilled on a physically restricted area, such as an island or pier from which a plurality of holes are drilled, from one location wells drilled at an angle into the formation so as to give greater penetration, multiple wells drilled from one location for the purpose of subsurface geological exploration. Under the second application come wells redrilled for the purpose of correcting excessive drift and direction, to straighten the well, to prevent trespass, to sidetrack lost tools, to direct the course toward the productive side of a fault, to direct a well back into a hole which caved in and was lost, and to direct the course of the hole away from edgewater into the productive zone.

The principal requirements are the correct use and interpretation of well surveying instruments and an accurate method of orientation and deflecting tools. Several methods and instruments are reviewed and illustrated.
A. H. N.

795. Directional Drilling in the Mid-Continent Area. C. P. Collins. *Oil Wkly*, 24.2.47, **124** (13), 32–34.—The many applications of directional drilling in the Mid-Continent area fall in the following general classifications: (1) Sidetracking and redrilling; (*a*) Sidetracking lost tools and drill pipe; (*b*) Correction of vertical drift and direction. (2) Drilling to pre-determined points; (*a*) Inaccessible surface locations; (*b*) Relief wells; (*c*) Fault lines; (*d*) Unconformities; (*e*) Gas, oil, and water contacts; (*f*) Geologic exploration and exploitation of stratigraphic traps.

Several illustrative examples are briefly described.
A. H. N.

796. Hydraulic Drives in the Oilfields. N. A. D'Arcy, Jr. *Petrol. Engr*, Feb. 1947, **18** (5), 90. (*Paper presented before A.I.M.E. Petroleum Division*, Los Angles, Oct. 1946.)—Hydraulic drives are of two types: (1) hydro-kinetic drives—which depend on the kinetic energy of the hydraulic fluid—*e.g.*, hydraulic couplings and hydraulic torque converters; and (2) hydrostatic drives—which depend on the pressure of the hydraulic fluid—*e.g.*, hydraulic motors and hydraulic pumps. The basic principles of these two types, and the characteristics, applications, and limitations of hydraulic couplings and torque converters and of hydro-static drives, generally, are each discussed. R. B. S.

797. Chemistry of Acid Treatments for Mud Removal. C. E. Clason. *Oil Wkly*, 24.2.47, **124** (13), 41.—The use of acid to remove mud containing carbonates is twofold in accomplishment, in that a double or greater base exchange is not only possible, but apparently takes place by solution of the carbonates. Muriatic or hydrochloric acid will accomplish this, and if not available, calcium chloride will be much more efficient in washing in wells than plain water in any type of formation. Mud with no carbonate can be more efficiently removed with a mixture of calcium chloride and acid, and calcium chloride alone is also more efficient than plain water. There should be no ingredients in the acid that form insoluble compounds with any of the mud constituents. Any acid whose salts are soluble will work, but hydrochloric is cheaper and universally used. The base exchange will always occur with any mineral acid but the Ca and Mg salts, when carbonates are present, should be soluble also to assist in replacing the Na of the clay. A. H. N.

Production.

798. Development of Well-head Equipment. J. E. Eckel. *Petrol. Engr*, Dec. 1946, **18** (3), 188.—A summary is presented of the development of well-head equipment during the last 20 years. R. B. S.

799. New Method for Increasing the Permeability of Sandstone Layers in Oil Wells. H. J. M. W. De Quartel. *Ingenieur*, 28.3.47, **59** (13), 9.—An electrical method is suggested using the well casing as the cathode, the anode being placed 3–6 ft under the production zone. The method is particularly useful for sandstone containing clay or firmly bound water.

It is also suggested that the method could be used for the breaking of water–oil emulsions. N. C.

800. Some Permeability Experiments on Cores from the Stevens Sand, Paloma Field, California. K. T. Miller, F. Morgan, and M. Muskat. *Producer's Monthly*, Nov. 1946, **11** (1), 31.—Experiments were performed to measure the permeability to oil in clay-containing sands, partially saturated with water or after exposure to water. The experimental procedure is described and the results are shown tabularly and graphically. The average ratios of permeabilities of the unextracted cores (*i.e.*, untreated cores as obtained from the formation) for oil, fresh, and salt water, to the permeability for air were found to follow three empirical rules, viz.—

$$\frac{k_o}{k_a} = 0{\cdot}43 \quad \frac{k_w}{k_a} = 0{\cdot}01 \quad \frac{k_{s.w.}}{k_a} = 0{\cdot}07.$$

The experiments also show that the permeability to oil after flooding with water is much less than prior to flooding. This supports the suggestion that oil-base muds should be used when drilling-in clay containing producing rocks. Six references are given. R. B. S.

801. Liner Job Well-Remedial Work in the East Texas Field. D. W. Akins, Jr. *Oil Wkly*, 13.1.47, **124** (7), 32.—Due to the shale streaks in the Woodbine sand being non-uniform in thickness, the production problems from this field are complex. The problems discussed in detail are, however, specific to the field and reference should be made to the charts and diagrams to understand the special solutions to them. The steps taken to exclude water or reduce it to a minimum are discussed in detail.

A. H. N.

802. Influence of Temperature on Oilfield from Uncemented Sands under Gravitational Flow. S. L. Zaks. *Petrol. Engr*, Nov. 1946, **18** (2), 147. (*Translated by A. A. Boehtlingk from paper published in Izvestiya Akademii Nauk S.S.S.R. (Otdelenie Tekhnicheskikh Nauk Bull Acad. Sci. U.R.S.S., Cl. Sci. Techn.).*)—The surface tension, viscosity, and adhesion tension of crude oil all decrease with increase of temperature, irrespective of the composition of the crude (provided this remains constant) or of the reservoir sand. There is, however, another factor to be borne in mind; it is that temperature increases will result in decreasing the volume of gas dissolved in the crude (thus varying its composition) and cause an increase in the viscosity of the oil, which will probably offset the expected decrease in viscosity due to rise of temperature. Experiments, which are described, were therefore devised for measuring the overall effect of temperature on oil yield. The crude used in these experiments was a light Maikop crude (S.G. 0·832) and the sand used was in two grades both being loose, uncemented sand having a porosity of 41·42%, but one having a grain size of 0·25–0·10 mm and the other having a grain size of 0·10–0·01 mm: the temperature range studied was from 20° C to 100° C, and the slope of the sand-packed tube was varied from 5° to 40°.

The results of these experiments, which are presented tabularly and graphically, show that increasing the temperature increases the oil recovery and that the maximum rise in % recovery was observed for increases in temperature from 20° C to 60° C. The temperature effect was also found to increase with decrease in grain size and with decrease in slope. The author concludes that heating oil sands, particularly those having small grain size and containing a high viscosity crude, would profitably increase the % recovery. Six references are appended. R. B. S.

803. Quick-Freezing Seals Fluid Content in Cores. J. D. Wisenbaker. *Petrol. Engr*, Jan. 1947, **18** (4), 75.—The usual methods of core cutting result in the flushing of cores by drilling mud and the expulsion of some fluids by the release and expansion of gas as the core is withdrawn to the surface. However, these processes are usually sufficiently consistent for a given set of reservoir conditions, that measurements of fluid saturations, porosity and permeability, if made upon the core *immediately on reaching the surfaces*, can be used to interpret the production to be expected. If, on reaching the surface, the core is not immediately attended to, it will begin to absorb more water from the drilling mud, and, on exposure to the atmosphere, it will begin to lose oil and water by evaporation: thus the value of a core analysis rapidly deteriorates with the delay. Research has shown that the most satisfactory method of preserving cores for a delayed analysis was by the use of a quick-freezing process.

Porosity and permeability measurements were made on a variety of consolidated sand cores before and after quick freezing (*a*) with cores fully saturated with water and (*b*) with cores partially saturated with gas, for various gas saturations up to 55% of pore space. The effect of quick freezing on oil and water saturation was also examined. The results are presented tabularly and graphically. They show that: (1) No appreciable change in porosity was caused by quick-freezing samples fully or partially saturated with water; (2) No appreciable change in permeability was noted for samples above 10% gas saturation; (3) Samples fully saturated with water but having permeabilities above 10 millidarcys showed no substantial change in permeability; (4) Samples fully saturated with water, but having permeabilities below 10 millidarcys showed some change in permeability; (5) The fluid saturations of cores appear to be preserved indefinitely: saturation analyses on cores at times varying from 20 hr to 30 days after freezing failed to detect any variation in fluid saturations.

The author concludes that the physical characteristics and fluid content of cores can be preserved almost indefinitely by quick freezing fresh-core samples as they are taken from the well. R. B. S.

804. Chemical Resolution of Oil-in-Water Emulsions. L. T. Monson. *Petrol. Engr*, Dec. 1946, **18** (3), 116.—The most common petroleum emulsions are the water-in-oil type, but in certain circumstances wells have been known to produce oil-in-water emulsions. High water–oil ratios, soft and somewhat alkaline waters, and dense crudes, are all conducive to this type of emulsion. They are less stable than the water-in-oil type and although the amount of emulsified oil remaining after settling is often

very small it is usually sufficient to cause pollution of surface waters if run to waste; prevention of this is the chief reason for its removal.

Increased settling time alone is not sufficient. Attempts were made by the use of alum and similar salts to produce a floc which would collect the oil by a filtering action as it settled to the bottom or rose to the surface. Unfortunately these reagents were very corrosive, and the oil recovered retained so much water that it had to be passed through the water-in-oil emulsion treating plant: however, the presence of the metallic floc electrolytes in the recovered oil completely upset the normal electrical and chemical methods of dehydration of water-in-oil emulsions and made them unworkable. The results forced the complete abandonment of this process. However, the use of several proprietary chemical reagents of undisclosed but complex chemical composition was found satisfactory for treating-oil-in-water emulsions: these reagents seem to present the only satisfactory solution to the problem. R. B. S.

805. Pressure–Temperature–Gravity Relations in Wells Producing Oil and Gas. Part 1. F. K. Beach. *Oil Wkly*, 17.2.47, **124** (12), 18–23.—In wells producing liquid phase oil and gas, the sp. gr. of gas in a static column is likely to be lighter than in a moving column even after removal of liquid oil in a separator; the gravity of the gas appears to be a function of the temperature gradient in the wells and the equilibrium conditions between liquid and gas hydrocarbons at the time static conditions are set up by shutting a well in. When a well produces only gas and condensate, gravitational sorting is insufficient to lower the gas gravity. When computing the weight of a gas column, the mean of conditions at 2–8/10 of the depth can be used to integrate for mean conditions in the column. From one family of curves representing pressure gradient in gas columns having a stated specific gravity and temperature gradient, corrections are developed for other gravities and temperatures. Conversely, given any two of the variables, the other can be found.

Methods used for determining the temperature and pressure gradients down a well and for calculating the gravity of the gas column as affected by these two factors as well as by water vapour and H_2S content and by the deviation of the compressibility of the gas from theoretically ideal states and laws are described. A. H. N.

806. Pressure–Temperature–Gravity Relations in Wells Producing Oil and Gas. Conclusion. F. K. Beach. *Oil Wkly*, 24.2.47, **124** (13), 35.—The mathematical derivation of the formulæ used for calculating the weight of a gas column in a well are given. Actual gradients of pressure in several wells are presented and analysed. Comparison with theory are made and practical application is suggested. A. H. N.

807. Recent Advances in Air–Gas Drive Recovery. D. E. Menzie, R. F. Neilson, and S. T. Yuster. *Producer's Monthly*, Dec. 1946, **11** (2), 14. (*Paper presented at the 10th Annual Secondary Recovery Conference, School of Mineral Industries, Pennsylvania State College.*)—Experiments were performed to determine the effect of absolute pressure (as distinct from pressure differential) on the performance of air–gas drive reservoirs. The results of these experiments showed that the absolute pressure has no effect on the time (*i.e.*, production rate) nor on the gas volumes as measured at the mean pressure. Experimental work also showed that increasing the water saturation at the same time as gas injection tended to increase oil recovery. Although these experiments were carried out on cores which were initially 100% oil saturated it seems that this general conclusion would apply at least to sands having a high initial oil saturation. Three references are appended. R. B. S.

808. Production from Long Cores by Air–Gas Drive. R. J. Day. *Producer's Monthly*, Jan. 1947, **18** (3), 16. (*Paper presented at 10th Annual Secondary Recovery Conference, School of Mineral Industries, Pennsylvania State College*).—Experiments are described for estimating saturation distributions in cores by measuring pressure distributions and relative permeabilities. These experiments showed that, in the case of certain sands, production was faster and less gas was required to reach a certain saturation when flowing from a higher to a lower permeability than when flowing in the reverse direction: applications of this fact to field practice are suggested. The use of diaphragms which are impervious to gas or to water and gas is also discussed. Six references are appended. R. B. S.

809. Corrosion Problems in High-Pressure Distillate Wells. R. L. Hock. *Oil Wkly*, 27.1.47, **124** (9), 33.—The cost of corrosion in producing from high-pressure distillate wells is briefly indicated. Several methods are followed in the Cotton Valley distillate field to detect corrosion. Some of these are: (1) During regular field work it is customary to inspect the field lines, tubing, valves, or equipment for corrosion as they are being changed, or worked upon. Experience has taught the field men which points and places are most likely to be attacked, thus aiding in detection. (2) Line walkers are used to continually patrol the pipelines, checking junctions, Christmas trees, and pipeline equipment. (3) Well checkers, whose principal function is regulating flow of wells, check every regular producing well at least twice a day for small leaks and report them when found. (4) Visual examination and checks of meter runs, flow lines, and equipment are made periodically by the welder and field crews by cutting them open for inspection where practical. (5) Penetron survey has been made on all regular producing wells, some of the expansion bends, gathering system junctions, and injection system loops. This type of survey permits inspection of lines without having to cut them open and allows normal operation of the lines while being tested. (6) Electrical surveys to determine need for insulating wells from flow lines. (7) Use of tubing calipers.

Several methods of reducing corrosion are available; at present sodium chromate is used in one well and a 5% by vol of naphthenic acid in seal oil is being found effective in preventing corrosion in 2 wells. Corrosion is found to increase with rate of production. A. H. N.

810. New Technique Combats Electrolysis. R. B. Walter. *Oil Wkly*, 3.2.47, **124** (10), 18–21.—With certain qualifications, corrosion may be said to be caused by chemical and electrolytic action. Some electrical action occurs whenever chemical compounds are dissolved and/or ionized, and new ones formed, so that to assert that one type of corrosion is purely chemical is incorrect. Nor can it be said that corrosion is purely electrolytic since there is an attendant chemical action when an element is dissolved by the electrolyte. Several chemicals or chemical compounds are now being used to combat chemical corrosion with varying degrees of success. About a year ago a new technique employing a mechanical or metallic treater was introduced to combat electrolytic corrosion or electrolysis, as it is properly called. The initial field of operations was an area in Southern California where electrolysis was so severe that only a two weeks' run for a pump was not uncommon. The treater, which was installed in a "hot" well and where electrolytic corrosion was more severe, consisted of a 15-ft rod threaded at each end, on which was strung an alternating series of copper and zinc plates, which began and ended with the former, so that there was one more copper plate than zinc. Each plate was separated from the next by a brass spacer ring. The plates and spacer rings were drawn together and held by nuts screwed on to each end of the rod. Several tests were made on very corrosive wells which show that the well equipment is protected at the expense of the zinc plates which are dissolved. The number of pulling jobs per month were consequently reduced. The action of the treater is explained. A. H. N.

811. Conversion Graph for Open Flows of Gas Wells. W. F. Martin. *Petrol. Engr*, Dec. 1946, **18** (3), 49.—Natural gas volumes are frequently reported at a pressure base of 16·4 p.s.i., whereas these data are often required based on a pressure of 14·65 p.s.i. (*i.e.*, atmospheric pressure). Conversion can be carried out rapidly by means of a slide rule or a conventional graph, but such computations are not sufficiently accurate for most purposes. The author has designed a graph to convert volumes based on a pressure of 16·4 p.s.i. to a pressure base of 14·65 p.s.i. This graph, which is illustrated, is capable of reading accurately to three decimal places, and its use is demonstrated by four examples. R. B. S.

812. Design, Installation, and Operation of Gas-Lift Equipment. L. F. Davis. *Petrol. Engr*, Dec. 1946, **18** (3), 60.—Gas-lift equipment is usually one of three main types. These are: (1) the automatic differential controlled flow valve, (2) the sp.-gr. controlled flow valve, and (3) the surface controlled intermitters and flow valves.

The automatic differential controlled flow valve is usually spring actuated; and is designed so that the valve opens to admit gas over a predetermined range of differential

pressure between the gas in the annulus and the fluid column in the tubing. The sp.-gr. controlled flow valve depends for its action on the differential pressure between a light oil and the fluid column in the tubing: when the sp. gr. of the fluid in the tubing is greater than that of the light oil, a diaphragm which separates them is flexed inwards so that the valve is open. The sp. gr. of the light oil is such that it is less than that of the static fluid column but greater than that of the aerated fluid column. Thus, when the fluid becomes aerated so that its sp. gr. is less than that of the light oil, the diaphragm is flexed outwards and the valve closes. Three types of intermitter valves are also discussed; these are: (1) wire line controlled, (2) casing pressure controlled, and (3) tubing controlled valves.

In designing a gas-lift installation the necessary data are: (1) the static liquid level, (2) the producing liquid level, (3) the submergence, (4) the gravity of the liquid, and (5) the gas pressure available. The various formulæ for determining valve spacing are briefly discussed.

Finally, the operation of gas-lift equipment is discussed and several examples from field tests are given. R. B. S.

813. Use of Plugging Agents. H. T. Kennedy. *Producer's Monthly*, Dec. 1946, **11** (2), 25. (*Paper presented before A.P.I.*, Chicago, Nov. 1946.)—See Abstract No. 356 (1947).

814. Pumping Unit Design Lowers Rod Acceleration. J. B. Wrigley. *Petrol. Engr*, Jan. 1947, **18** (4), 92.—The author derives the following expression for polished rod acceleration:

$$a = \frac{w^2 r L}{l}\left[\cos\theta + \frac{c\cos 2\theta + c^3\sin^4\theta}{(1 - c^2\sin^2\theta)^{3/2}}\right]$$

where a = polished rod acceleration w = angular velocity of wrist pin, r = crank radius, L = distance of polished rod from samson post measured along walking beam, l = distance of upper pitman bearing from samson post θ = wt, crank angle from vertical, c = ratio of crank radius to pitman length: all dimensions are in feet, seconds, and radians. Using this formula the author suggests a new design for pumping units having a lower ratio of crank radius to pitman length, and with crank and pitman on the same side of the samson post as the well. This design would reduce the polished rod acceleration resulting in increased sucker rod life. R. B. S.

815. Power Distribution Systems for Oilfield Pumping Service. Part 3. W. C. Bloomquist and J. N. Moore. *Oil Wkly*, 13.1.47, **124** (7), 46.—In this, the concluding part of the paper, extensive tabulated and graphical data are presented for line resistances and voltage drops, transformer bank requirements, loads and voltage drops, and for costs. Typical oilfield installations and costings are analysed in some detail and problems solved in full. A. H. N.

816. Secondary Recovery and Natural Gasoline Industry are Developments of Bradford Field. G. G. Bauer. *Producer's Monthly*, Nov. 1946, **11** (1), 22.—The developments of water-flooding practices and of the methods for the extraction of natural gasoline in the Bradford field are briefly reviewed. R. B. S.

817. A Study of the Possible Application of Capillary Diaphragms in Secondary Recovery. K. W. Smith and S. T. Yuster. *Producer's Monthly*, Nov. 1946, **11** (1), 39. (*Paper presented at the 10th Annual Secondary Recovery Conference, School of Mineral Industries, Pennsylvania State College.*) The existence of semipermeable diaphragms is well known in the laboratory: these may be regarded as consisting of a bundle of minute capillaries which allows the passage of a wetting fluid under any positive pressure but resists the passage of a non-wetting fluid at all pressures below the displacement pressure. The displacement pressure is defined as the pressure necessary to cause a non-wetting fluid to penetrate a permeable medium which is 100% saturated with the wetting fluid: it can be defined mathematically by the equation:

$$P = \frac{1}{r}\,2T\cos\sigma$$

where P = displacement pressure, r = radius of capillary, T = interfacial tension,

σ = contact angle; thus if r is very small (as in a semipermeable diaphragm) P is very large, and the diaphragm is effectively impermeable to non-wetting fluids at all ordinary pressures.

Research has been carried out in an attempt to find a diaphragm that would permit the passage of oil and not of gas or water, and that could be adapted to field use (*i.e.*, to line the face of a producing sand). It is not sufficient to make the sand face oil-wet since the displacement pressure is only small (the radius of curvature factor for a permeable sand being large): in fact the gas–oil or water–oil ratios would be expected to increase under these circumstances since the effective permeability of a non-wetting fluid is always greater than that of a wetting fluid.

A diaphragm adaptable to field use must therefore meet two essential requirements: (1) the displacement pressure must be in the range of hundreds or thousands of p.s.i. (*i.e.*, above the reservoir pressure; otherwise water—the non-wetting fluid—will also pass through it) and (2) it must be stable under these high pressures. Calculations show that permeabilities of the order of 10^{-5} to 10^{-6} md are necessary to produce diaphragms having a displacement pressure of 200 p.s.i., but it should be noted that: (1) the thickness of the diaphragm is very small and the production rate *may* not be affected to the extent that this low permeability may suggest, and (2) the displacement pressure is not a function of thickness so this may be as small as is consistent with stability.

The problem of getting a diaphragm in the well may be solved by the use of one of three methods: (1) injection of fluids which will react and precipitate a diaphragm on the sand face, (2) supporting the diaphragm on a liner, and (3) injecting suitable materials with the cement to build a sheath around the well bore. Preliminary laboratory and field experiments have so far indicated that it is possible to form diaphragms having a permeability to oil of 0·1 md corresponding to a displacement pressure of 6 p.s.i. by two methods: (1) injection of a 1% amine acetate solution followed by a 1% sodium disilicate solution and a 0·1% solution of octadecylamine, and (2) supporting an aggregate of finely ground galena (treated with either potassium amyl xanthate or sodium oleate) and colloidal graphite or carbon black on a liner; antimony sulphide could be used in place of galena. Carbon-black diaphragms, having displacement pressures up to 60 p.s.i. were made, but these were unstable when tested in the field. Other substances were tested, notably silicones, but without satisfactory results.

Diaphragms for field use need to have displacement pressures much above 60 p.s.i. It is believed that further experimentation could produce a diaphragm having the required displacement pressure, but it may not be possible to produce them sufficiently thin to prevent much effect on production.

Four references are given to papers, and 8 to patents. R. B. S.

818. Secondary Recovery Production Research. (A Monthly Review). Low pH Waters Show High Throughput Rates in Laboratory. R. V. Hughes. *Producer's Monthly*, Dec. 1946, **11** (2), 8.—The effect of the pH of input waters on throughput rates seems to depend on the principles of base exchange between the water and the clay minerals in the sands, since these govern the degree of flocculation: flocculated clays tend to be more permeable than deflocculated clays. Another factor may be the removal of cementing material by the chemical action of low pH waters.

In general, low pH waters seem to be preferable for water flooding since they are usually conducive to higher input rates and are inhibitory to organic growth. Unfortunately they are corrosive in most circumstances, but promising work has recently been done in the field of corrosion inhibition.

Three references are given. R. B. S.

819. Chemical Agents in Water Flooding. P. L. Terwilliger and S. T. Yuster. *Producer's Monthly*, Nov. 1946, **11** (1), 42. (*Paper presented at 10th Annual Secondary Recovery Conference, School of Mineral Industries, Pennsylvania State College.*)—It is well known that water-soluble surface active agents capable of reducing oil–water interfacial tensions are not suitable for field use owing to the fact that they concentrate at the interface and are absorbed by the sand body. Experiments were therefore carried out to test the value of the following methods for reducing oil–water interfacial tensions: (1) pumping a solution of oil-soluble wetting agent into the sand ahead of the water, (2) injecting reactive gases into the sand before flooding, and (3) using water-

soluble surface inactive agents which disperse throughout the water body instead of concentrating at the interface and are less likely to be absorbed. These experiments are briefly described.

The experimental results show that: (1) oil-soluble wetting agents do not increase recoveries, and they are also absorbed by the sand; (2) reactive gases did not give encouraging results; and (3) water-soluble surface inactive compounds appeared to have no effect. R. B. S.

820. Capillary Pressure in Secondary Recovery. J. W. Amyx and S. T. Yuster. *Producer's Monthly*, Dec. 1946, **11** (2), 10. (*Paper presented at 10th Annual Secondary Recovery Conference, School of Mineral Industries, Pennsylvania State College.*)—The application of capillary pressure data to secondary recovery problems includes determination of connate, water saturations, residual oil saturations, and similar fundamental properties. The capillary pressure-saturation relations must be considered as involving three phases, *i.e.*, gas, oil, and water. A preliminary study was made of the four basic systems: (1) air into oil, (2) air into water, (3) oil into water, and (4) water into oil.

The preparation of samples and the experimental technique are each described. The principle of operation of the apparatus is that of applying an external pressure to the displacing fluid, thus causing flow of the saturating fluid until equilibrium is reached in the system. At equilibrium the capillary pressure of the saturating fluid is equal to the pressure of the displacing fluid. The volume of fluid displaced is measured by the difference in readings in a pipette, and thus the corresponding fluid saturations could be determined. The relation between capillary pressures and the corresponding fluid saturations was determined for three cores having permeabilities of 2 md, 35 md, and 314 md and the results are presented graphically: these results confirm the findings of other investigators, and it is recommended that further work be done on these lines.

Six references are appended. R. B. S.

821. Bacteria Helps to Produce Oil. Anon. *World Petrol.*, 1947, **18** (3), 76–77.—The paper describes further (see Abstract No. 54 (1947)) the work of ZoBell on the rôle of bacteria in oil production (A.P.I. Project 43A). It has been established that certain bacteria can carry out their life cycles under the conditions prevailing at great depth in the earth's crust, and they can physically displace films of oil from sediment particle surfaces by reason of their marked affinity for solid surfaces. Pennsylvania Grade Crude Oil Association is co-operating in large-scale field trials to use this bacterial detergent action to assist in secondary oil recovery. F. S. A.

822. Unitization Programme for West Cement Medrano. K. M. Fagin. *Petrol. Engr*, Feb. 1947, **18** (5), 160.—The proposed plan of unitization for the Medrano sand pool in the West Cement field of Oklahoma is reviewed. Some brief data are given on production, reservoir data, and recovery estimates for this pool. R. B. S.

823. History of Water Flood Development. D. T. May. *Producer's Monthly*, Nov. 1946, **11** (1), 24.—A brief account is given of the developments in flooding patterns, pressure plant, coring, research, and water treatment in the Bradford field. R. B. S.

824. Fundamental Chemistry of the Effects of Hydrogen Ions on Water Intake Rates of Oil Sand. L. E. Miller. *Producer's Monthly*, Nov. 1946, **11** (1), 35.—The properties of such clays as are usually found associated with oil sands, and the effects of contacting these clays with various types of water, are discussed.

Clay will absorb water added to it until, when sufficient water is added, a plastic mass is formed, this absorption being accompanied by swelling. Further addition of water causes a separation of the clay particles with the formation of a dispersion. The data examined lead to the following generalized conclusions: (1) The isoelectric points (which define the conditions of minimum swelling) for the clay ampholytoids present in oil-bearing sands are on the acid side of neutrality; (2) Flood waters of low pH will tend to cause shrinking and flocculation of these clays—this permits greater flood water intake rates; (3) Neutral flood waters and flood waters of high pH tend to swell and

deflocculate the clays; (4) Brines have an effect similar to flood waters of low pH; (5) Flood waters so low in pH as to have entered the zone of increased swelling on the acid side of the isoelectric point are unlikely to be used owing to their extreme corrosivity; (6) It seems probable that the concentration of ions other than the hydrogen and hydroxyl ions may also effect the swelling of clay minerals.

An excellent bibliography of 84 references is appended. R. B. S.

825. Water-Flood Tests on Long Cores. R. A. Morse and S. T. Yuster. *Producer's Monthly*, Dec. 1946, **11** (2), 19. (*Paper presented at 10th Annual Secondary Recovery Conference, School of Mineral Industries, Pennsylvania State College.*)—The paper describes experiments devised to study the effect of pressure gradients (*i.e.*, pressure differentials) on the residual oil saturations of water-flooded cores. The experimental results are shown tabularly and graphically and lead to the following general conclusions: (1) flooding gradients have little effect on the residual oil saturations, and (2) the properties of the oil, and especially its content of polar compounds, effect its recovery by water flooding.

One reference is appended. R. B. S.

826. Following Air–Gas Drive with a Water Flood. R. V. Hughes. *Producer's Monthly*, Jan. 1947, **11** (3), 8.—A brief description is given of some experiments designed to test the effect of flooding cores of Venango sand which have been subjected to gas drive. Although many operators believe that the Venango sands cannot be successfully flooded, these experiments seem to suggest that a water flood following an air–gas drive would be economical for this type of sand. The author suggests that further work be done on the selines to test the validity of these results. Seven references are appended. R. B. S.

827. Control of pH in Flood Water Treatment. Anon. *Oil Wkly*, 24.2.47, **124** (13), 52.—The elements of pH significance, measurements, and control are presented. The effect of pH on corrosion rates are similarly briefly discussed. A. H. N.

Oilfield Development.

828. July Completions Down: Upward Trend Expected. Anon. *Oil Wkly*, 19.8.46, **122** (12), 71.—During July 2328 wells were completed in U.S.A. 1238 found oil and 187 found gas. The average rate of completion up to the end of July was 530 per week compared with 48 per week for the same period of 1945. 2398 wells were completed in June 1946. Compared with 1945, Texas, Oklahoma, Louisiana, Colorado, Illinois, Indiana, Kansas, and Kentucky show increased completion rates, while California, New Mexico, Mississippi, and West Virginia show decreased rates.

A table summarizes by States and districts the U.S.A. completion results for July and for the first 7 months of 1946. G. D. H.

829. New Oil Reserves Discovered in 1946. H. J. Struth. *Petrol. Engr*, Feb. 1947, **18** (5), 43.—A brief review is given of new reserves discovered in the U.S. in 1946: most of these were additions to developed fields. The cost of finding oil is also discussed. R. B. S.

830. Deep Exploratory Wells on Increase. E. Adams. *Petrol. Engr*, Feb. 1947, **18** (5), 51.—The increase in deep exploratory drilling during recent years is briefly discussed. A tabulated summary of data on 325 wells drilled to 12,000 ft and over is also presented. These data consist of (1) total depth and elevation, (2) date spudded, (3) date completed, (4) company and well, (5) location, county, and state, (6) deepest formation, (7) producing formation, (8) casing schedule, (9) initial production (if any), (10) crude gravity, (11) choke diameter, (12) pressure, (13) gas–oil ratio, and (14) other remarks. The table is right up to date, the last entry being the 16,668 ft Pacific Western Well drilling in Kern County, California. R. B. S.

831. Bradford Field Production. G. G. Bauer. *Producer's Monthly*, Nov. 1946, **11** (1), 29.—A brief survey is given of the production from the Bradford field from the time of the discovery of the Bradford Third Sand in 1871. R. B. S.

832. Third Spring Hill Test Comes in as Gas Well. Anon. *Oil Gas J.*, 26.10.46, **45** (25), 78.—Spring Hill 3 has found the sand 111 ft higher than in the discovery well. The casing is set at the top of the sand and the gas–oil ratio will be too high for the well to be produced in its present condition. A fourth well is to be drilled ½-ml to the east.
G. D. H.

833. Sinclair Panama Given 20-Year Concession for Isthmian Production. W. W. Burns. *Oil Gas J.*, 5.10.46, **45** (22), 42.—Sinclair Panama Oil Corp. has recently been granted concessions covering 17,762,500 acres in Panama. A summary of the conditions is given.

A number of dry wells have been drilled in past years, and the Garachine well had some non-commercial production. Gas was struck in one of the wells drilled on Columbus Island.
G. D. H.

834. Creole's August Output at 581,519 Brl Daily. Anon. *Oil Gas J.*, 19.10.46, **45** (24), 94.—Creole brought in 23 wells in August, 9 at Bolivar Coastal, 8 at Jusepin, and 1 each at Mulata, Quiriquire, and San Joaquin. There were 3 successful exploratory wells.
G. D. H.

835. Europe's Lagging Production. W. N. Small. *Oil Wkly*, 5.8.46, **122** (10), 16.—In the past 2 years Europe's oil production has been below 1938 levels. During the past few years the U.S.S.R. production is estimated to have been 18–25 million metric tons per year. During the war some 3000 wells were destroyed, their annual yield being 5 million tons. Devonian oil has been found in the Samara Bend, in Tuimazy, at Severokamsk, and Shuguarovo. In the Baku area a new oilfield has been found at Buzovny. Tash-Kala is a new field in the Grozny area.

Roumania's production is estimated to have been 4,640,000 metric tons in 1945. This compared with 3,507,000 tons in 1944 and 8,700,000 tons in 1936. 524,400 ft was drilled in 1945, about half the pre-war average. Some refineries were rebuilt in 1945.

In 1944 Austria produced 1,210,000 metric tons of oil. The 1945 output was 550,000 tons according to one estimate. Production is being obtained at Zistersdorf, Hokensruppersdorf, and Muehlberg. Oil deposits are said to be under investigation near Vienna, Graz, and elsewhere in the Alpine foothills.

Hungary's main field is at Budafapuszta. In 1944 the output exceeded 800,000 tons. Bukkszek is a small field in the northeast. Output declined to 650,000 tons in 1945. During 1940 Germany's production may have exceeded a million tons; it declined to about 700,000 tons in 1944, and possibly 500,000 tons in 1945. Poland's production fell from over 500,000 tons/year before the war to 350,000 tons in 1944. The richest producing area was ceded to Russia. Albania's production may have reached 200,000 tons/year, but may have been only 100,000 tons in 1944.

During 1943 Britain produced 100,000 tons; at the end of 1945 the rate was 70,000 tons/year. Germany raised France's production to over 75,000 tons/year; in 1945 the rate was about 56,000 tons. During the war Czechoslovakia's production rose to about 30,000 tons, while Italy's output may have been 12,000 tons/year. The Dutch production at Coevorden is stated to be about 1200 tons/month. Yugoslavia produces relatively small amounts of oil from an area near the Hungarian border.

A table gives the European oil production by countries for the years 1938, 1944, and 1945.
G. D. H.

836. Zistersdorf Output. Anon. *Oil Wkly*, 5.8.46, **122** (10), 38 (International Section).—The Zistersdorf area is now reported to be producing at the rate of about 27,100 brl/day.
G. D. H.

837. Extensive Prospecting Licenses Promise Further Exploration in Britain. W. A. Macfadyen. *Oil Gas J.*, 21.9.46, **45** (2).—Currently the D'Arcy Exploration holds prospecting licenses covering nearly 13,000 sq ml in England, and Anglo-American holds licenses covering 4,000 sq ml.

A *résumé* of the oilfield developments in Britain is given, together with a map showing the licensed areas.
G. D. H.

838. Search for Natural Gas Begun in Czechoslovakia. Anon. *Oil Gas J.*, 12.10.46, **45** (23), 61.—Gas with 90–95% of methane has been found in a large-scale search begun in Moravia, near the Polish border. Several tests, mainly shallow, have been drilled in the Austrian province of Burgenland in the region of the lower Pinka River. G. D. H.

839. France's Exploration Programme Broadened. Anon. *Oil Wkly*, 5.8.46, **122** (10), 20 (International Section).—Pechelbronn is still France's principal oil-producing area. Its March output of 33,500 brl compared with a pre-war average of 45,000 brl/month. Half the production is from wells and half from the tunnels in the oil sand.

The discovery of oil on the Marcet anticline in the Aquitaine basin was made in 1939. At a depth of 6365 ft production of 150 brl of oil and 6½ million cu ft per day was obtained for 4 days. The reservoir is in steeply dipping Jurassic beds. Gas wells have been completed on two domes east of St. Marcet.

The French refining capacity has been raised to 17 million brl/year by reinstating some of the damaged refineries.

The "Pool des Carburants" is being continued. It handles imports of oil and oil products, and acts as a clearing house for all sales and costs and tries to utilize all available facilities for refining, transportation, and distribution.

At present France imports most of her oil from U.S.A., South America, and the Middle East. G. D. H.

840. France Making Strenuous Efforts for Production Within Own Borders. Anon. *Oil Wkly*, 19.8.46, **122** (12), 32.—12 wildcats are being drilled in the south of France and one at Soufflenheim, near Pechelbronn.

The St. Marcet field has 5 gas wells with a potential of 15,000,000 cu ft/day. 1 oil well yields 20 brl/day. G. D. H.

841. Italian Producer Reported. Anon. *Oil Gas J.*, 14.9.47, **45** (19), 63.—A well producing gas and traces of oil has been drilled near the crest of the Lodi structure. 2 wells under way down flank have shown only traces of oil and gas. G. D. H.

842. Roumania's Drilling Activities Slowed. Anon. *Oil Wkly*, 5.8.46, **122** (10), 35 (International Section).—During the first quarter of 1946 Roumania's drilling averaged 27,500 ft/month, 37% below the 1946 average. Oil production averaged 85,500 brl/day; the average for 1945 was 93,000 brl/day. Lack of equipment, coal, and transport is responsible for the drop. Government control on the oil industry has tightened with a view to fulfilling commitments to Russia.

In 1945 the Russians built a 10-in pipeline from Faurei to Reni. This branches from the old Ploesti–Constantza line. A 10-in gas line from Transylvania to Bucharest is planned.

Tables give drilling and production figures. G. D. H.

843. Russia's Oil Projects in Eastern Areas. Anon. *Oil Wkly*, 5.8.46, **122** (10), 27 (International Section).—Russia aims to reach pre-war levels of oil extraction and refining in 1949. Special efforts are to be made in the Urals, Bashkir ASSR, Volga Basin, Sakhalin, Turkmenian SSR, and Ukranian SSR. New refineries and pipelines are to be built, as well as factories for producing oilfield equipment. It is hoped that gas production from coal and shale will be about 67,000 million cu ft by 1950, with natural gas production 295,000 million cu ft. The underground gasification of coal is to be continued, and the conversion of coal and oil shale to liquid fuel is expected to be at the rate of 6,300,000 brl/year by 1950. The oil-shale areas of the Estonian SSR have a capacity of about 65,800,000 brl and those of the Leningrad area 27,000,000 brl. Plans are being laid for an output of 254,880,000 brl annually 5 years hence.

The Baku area still provides more oil than all the other producing areas together. New deep sands have been tapped, and drilling has been begun on reclaimed land. Considerable development has taken place between the Volga and the Urals. area produces from the Devonian in addition to other formations.

Extensive directional drilling is taking place at Samarskaya Luka. There are large oil-bearing areas in eastern Turkmenistan. G. D. H.

844. Russians Plan Development for Eastern Turkmanistan. Anon. *Oil Gas J.*, 14.9.46, **45** (19), 62.—Nebit-Dag produces 13,650 brl/day from 146 wells. A gusher was drilled in 1931 and this is reported to have produced 2,100,000 brl of oil in 18 days.

A 5-year plan is said to visualize the attainment of an output of 420,000,000 brl/year. G. D. H.

845. Russians Plan Exploitation of New Central Volga Area. Anon. *Oil Gas J.*, 14.9.47, **45** (19), 63.—Wells are reported to have been successfully completed recently in Kamchatka and Sakhalin, while exploitation of important oil accumulations near Ulyanovsk, in the central Volga region, is scheduled. G. D. H.

846. Eastern Russian Oil Find is Reported. Anon. *Oil Gas J.*, 21.9.46, **45** (2), 163.—3 wells are reported to have been completed in the Tatarsk area. G. D. H.

847. Russian Writers Say Soviet Reserves World's Greatest. Anon. *Oil Gas J.*, 26.10.46, **45** (25), 78.—Ivanov and Poznanskaya state that in 1937 the Russian oil reserves were estimated at 45,000,000,000 brl, about 55% of the world's "visible" reserves. Production in 1940 is estimated at 217,000,000 brl, and should attain 248,000,000 brl in the current 5-year period. It will reach 420,000,000 brl by 1945.

The Kuibyshev fields have four times their pre-war output. G. D. H.

848. Egypt's 1945 Production Over 9·4 Million Brl. Anon. *Oil Wkly*, 12.8.46, 122 (11), 46.—It has been reported that in 1945 Ras Gharib produced 8,940,113 brl and Hurghada 465,928 brl. Gemsa gave 730 brl and Abu Durba 1900 brl. G. D. H.

849. Iranian Production at 383,366 Brl Daily in June. Anon. *Oil Gas J.*, 19.10.46, **45** (24), 94.—Iran produced about 11,501,000 brl of oil in June, giving a total of 69,475,000 brl for the first half of 1946. G. D. H.

850. Prospecting in the Punjab and the Northwest Frontier Province. E. S. Pinfold. *Petrol. Times*, 1.2.47, **51**, 119.—A brief account is given of exploration in the N.W. Frontier Province from 1866 when the first test wells were drilled in the Attock District. Since then extensive tests have been carried out in some 20 districts of which only 4—Khaur, Dhuhan, Joya Mair, and Balkassar—have so far yielded any significant production. R. B. S.

851. Japanese Oil Production Shows Decline for Year. Anon. *Oil Wkly*, 12.8.46, 122 (11), 46.—During the year ended March 31, 1946, Japan produced 1,482,578 brl of crude, 166,389 brl less than in the preceding year. Production is now hindered by shortage of parts for repairs, and if all suspended wells were put in operation output would probably rise by 10%. G. D. H.

852. 63 Million-brl Reserve is Estimated for Nippon. Anon. *Oil Wkly*, 19.8.46, **122** (12), 32.—It is estimated that reserves in the Hokkaido, Akita, Yamagata, and Niigata areas are 62,900,000 brl. In the 1945–46 fiscal year output was 1,482,500 brl. G. D. H.

Transport and Storage.

853. Material Economy in Petroleum Storage Installations. G. Daric. *Chim. et Ind.*, 1947, **57**, 228–240.—Tankage represents 20% of the capital cost of refineries and 40% of that of storage installations. At the end of the war French storage capacity was reduced to $10^6 m^3$, a deficit of $1{\cdot}6 \times 10^6 m^3$, which would call for 60,000 tons of steel (excluding tankage at refineries, the figures for which are approximately the same again). The redesigning of damaged storage installations both at the "national" and "local" level on more economical lines, taking full advantage of inter-connection and mutual planning between installations, could effect an economy of 30%. The use of standard tankage of a more economical design is suggested. Evaporation losses and

recent tank design for the storage of products of various v.p. are discussed. Tank interconnection to decrease breathing losses is advocated. Pressure tankage of French design is being developed, some details of the "Caquot" type, a specimen of which (3500 m^3) is actually in use, are given. V. B.

854. War-time Underground Oil Storage in Britain. M. Noone. *Petrol. Times*, 15.2.47, **51**, 161.—The design and construction of underground storage tanks used in Britain during the war is described in detail. These tanks consist essentially of steel-lined concrete chambers. R. B. S.

855. Pipeline Technology. H. H. Anderson. *Pipe Line News*, Dec. 1946, **18** (12), 12. (*Paper presented before A.P.I.*, Chicago, Nov. 1946.)—Developments in war-time and post-war pipeline technology are discussed under the following headings: (1) improving older lines; (2) improving maintenance methods; and (3) new construction methods. Trends in new line design are also reviewed. R. B. S.

856. Electric Power for Pipeline Pumping. A. N. Horne. *Pipe Line News*, Feb. 1947, **19** (2), 4.—The present trend in pipeline design is toward the use of larger diameter lines, fewer pumping stations, and simplified pumping equipment. The author suggests that electrical pumping methods are adaptable to these changes and that electric power for pipeline pumping is more economical than other sources of power. R. B. S.

857. Railroad Tunnels, Submarine Sections, Climate Pose Rugged Pipeline Problems. P. Reed. *Oil Gas J.*, 8.3.47, **45** (44), 60.—Brief details are given of the design and installation of the 4, 6, and 10-in pipelines laid in the Budg Budg–Tunsuki, Budg Budg–Kalukooda, and Chillagong–Tunsuki districts, and two submarine loading lines at Chillagong, Bengal Bay, India. The methods used in the construction of the latter, which consisted of 8000 ft lengths of 10-in pipe, called for new techniques in the laying. At the terminal, tides ranged from 9 to 17½ ft leaving at low tide 2000 ft of beach exposed. The sea-loading end was planned to lie in 42 ft of water at 8000 ft from high-tide mark. Current flows of 6–7 mph were usual. The construction and launching of the line was accomplished as follows: 6000 ft of rail track was laid inland from high-water limit, and this length of piping was welded and supported on 6½ ft of pipe, fitted with 4 disc guides placed one on the inside of each rail and one on each side of the pipeline. To secure the towing line a nipple of 4-in pipe was welded through the 10-in pipeline close to its "orange peel" welded plug end. The 1½-in towing cable was passed through the nipple and secured by two turns round the pipe and by two wire line clamps. The actual delivery outlet was a 6 ft length of 10-in pipe welded to the main pipe at 45° at the end of which a rotary drilling hose and valve was attached. After launching, a cable was attached to the hose for raising it when required, and this was tied to a marking buoy. Launching the line was made by first pulling the line by 4 tractors 2000 ft at low tide, then welding on the extra 2000 ft required and placing it on the vacated portion of the rail track. At high tide the whole length was towed to its planned position by a 1400 h.p. tug, assisted by 4 tractors on land. Ditching by native labour and an unusual type of plough which was designed on the job, are discussed. W. H. C.

858. Valve Progress in the Oil Industry. G. A. Bennett. *Petrol. Times*, 15.3.47, **51**, 215.—Progress in valve design for use in the oil industry is outlined. The types of valves which are briefly discussed are: (1) Newman–Milliken valves; (2) general purpose valves; (3) bar stock-valves; (4) cast iron and steel gate-valves; and (5) forged steel valves. R. B. S.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

859. Expansion at Haifa Refinery to Result in Capacity of More than 100,000 Brl Daily. Anon. *Oil Gas J.*, 8.3.47, **45** (44), 42.—A brief outline is given of the Consolidated Refineries, Haifa, refinery jointly owned by the Anglo-Iranian and Anglo-Saxon Com-

panies, which first began operating late in 1939, and of the subsequent extensions made up to 1944. At that date the crude oil topping facilities consisted of 3 × 26,000 brl/day units, affording a throughput of 4,000,000 tons/year. The 360-acre refinery area is situated along the small river Kishon, and is about 3½ ml from Haifa Port. The refinery is served by 12-in pipelines: (1) from Kirkuk–Haifa, and (2) by the Kurkuk–Tripoli line, and then by tanker to Haifa, thence by pipeline to the refinery. The new equipment to be installed includes a fourth crude-oil unit of the same capacity, ordered from Badger and Sons, Boston, and a lub oil plant consisting of 2 vacuum-distillation units to process 24,000 brl/day of reduced crude, designed by Badger and Sons; 2 propane-deasphalting units designed by the Kellogg Co., and the following plant designed by the Lummus Co.; 2 furfural-extraction units; 2 M.E.K.-dewaxing units and a clay contacting plant. Other additional equipment will include new facilities for producing high-quality kerosine, extra storage for 1,800,000 brl, extra laboratories, workshops, offices, and stores; and 2 more 6000 kw/hr turbo-generators; 3 new 150,000 lb/hr Spearing boilers to operate at 500 p.s.i.; and 2 giant parabolic shape water-coolers for 2,000,000 gal/hr water, operated by 30,000 g.p.m. pumps. These coolers are 250 ft high with a base diameter of 250 ft; the new construction will be mainly British.

W. H. C.

860. Refining Processes and Their Automatic Control. Anon. *Oil Gas J.*, 22.3.47, **45** (46), 149.—31 flow diagrams of modern processes with descriptive data and fold-out insert flow diagrams of modern refining processing, combined and correlated with a list of all the principal products obtainable from petroleum are given.

Processes dealt with include atmospheric and vacuum distillation, *cycloversion*, Houdry, suspensoid, thermofor catalytic cracking, hydroform and catalytic polymerization, naphtha polyform, thermal cracking, HF and sulphuric acid alkylation, Girbotol process, Perco copper sweetening, tannin solutizer, unisol and mercapsol processes, phosphoric acid polymerization, Perco and phosphate desulphurization, butane isomerization, Gray-clay treating, duo-sol furfural and phenol solvent extraction, M.E.K. and propane dewaxing, propane deasphalting, Houdry and Universal dehydrogenation, Universal isomerization, and hydrocol processes.

G. A. C.

861. Equipment Heat Losses (B.Th.U Per Hour Per Square Foot). (Refiner's Notebook, No. 129.) W. L. Nelson. *Oil Gas J.*, 1.2.47, **45** (39), 71.—The heat losses B.Th.U./hr/sq ft) are given for the following materials when operated at several temperatures, and under various conditions of air temperature and wind velocity: bare metal (breeching, stacks, and pipe); 1-in and 3-in magnesia lagging for vessels and towers; 3 thicknesses of magnesia pipe lagging at 80° F air temperature, for 3, 6, and 12-in pipe; furnaces of different bricks and brick thicknesses, with 3 thicknesses of insulation, or not insulated, with wind at 20 m.p.h., and at 100° F.

W. H. C.

862. Draft in 100-ft Stacks. W. R. Nelson. *Oil Gas J.*, 12.4.47, **45** (49), 103.—No. 139 in the *Refiner's Notebook* series gives tables showing approximate friction loss up to 300 ft of stack, effect of altitude up to 8000 ft, approximate effect of weather, and draft produced by 100 ft steel stack under driving rain or snow at sea level.

G. A. C.

863. Theoretical Stack Draft. W. R. Nelson. *Oil Gas J.*, 15.3.47, **45** (45), 101.—No. 135 in the *Refiner's Notebook* series discusses theoretical stack draft and displays a convgntional table giving average temperature of gases and available static stack draft at sea level. A formula for computing friction loss is given, and a table shows effect of altitude on draft.

G. A. C.

864. Transfer-Line Vaporization. (Refiner's Notebook, No. 134.) W. L. Nelson. *Oil Gas J.*, 8.3.47, **45** (44), 101.—Tables are given from which, in conjunction with the temperature drop and pressure drop taking place in the line (*Refiner's Notebook*, Nos. 128 and 132), the transfer-line vaporization can be determined. The tables have been prepared for atmospheric towers operated at 1–15 p.s.i.g., but probably reasonably accurate up to 60 p.s.i.g., and for charge stocks having true boiling-point slopes of 4·0 and 7·0, the throughput is based on the cold velocity (60° F) in the line. The approximate % vaporization taking place in the transfer line is obtained as follows: Estimate vaporization in tower; compute the cold velocity in the line; compute equivalent

length of line, and read the % vaporization that occurs in the transfer line. The vaporization at pipe-still outlet equals tower vaporization less the vaporization occurring in the transfer line. W. H. C.

865. Transportable 150-h.p. Hoists. Anon. *Petrol. Times*, 12.4.47, **51**, 326.—The construction and operation of transportable 150-h.p. hoists is described. These hoists are designed for the erection of refinery equipment, such as fractionating towers and columns of various types up to a weight of 225 tons. R. B. S.

Cracking.

866. Catalytic Cracking of Petroleum Oils. D. A. Howes. *Industr. Chem.*, 1947, 23, 217–225.—A general summary of cracking processes is given, together with a description and illustration of the electrically operated 100 gal/day fluid catalyst pilot plant of Anglo-Iranian Oil Co. at Sunbury-on-Thames. It is separately housed in a 55 ft high building with its own control laboratory. Six 500 gal feed and product tanks are housed under an adjoining shelter and an extensive instrument panel is provided. F. S. A.

867. New Delayed Coking Unit Increases Intermediate Distillate Yields. R. Maass and R. E. Lauterbach. *World Petrol.*, 1947, **18** (1), 48–52.—Owing to the market demand for gas oil the General Petroleum Co., in keeping with the general trend, has installed a Kellogg delayed coking unit to process 300–700 S.S.F./122° F straight-run residuum. Details of the plant, including materials of construction, layout, and operation are given, together with a simplified flow diagram and photographs. Delayed coking is accomplished by designing each of the two furnaces for high throughput and heat transfer. Each furnace has 2 coke drums for continuity. 1 coke drum is taken off-stream every 12 hrs and is on-stream again after 24 hr. The clearing process is described in some detail. At present the unit is charged with 15,000 brl/day 700 S.S.F./122° F straight-run residuum from Wilmington Crude (recycle/fresh feed ratio is 0·31 : 1). Some 22% de-butanized high sulphur gasoline, 53% gas oil (two grades), and 19% coke are produced, together with some gas. The plant is 75% self-supporting for steam. F. S. A.

868. Regeneration of Spent Catalyst in Fluid Catalytic Cracking. J. F. Snuggs. *Oil Gas J.*, 15.3.47, **45** (45), 88.—A review of descriptions of the oil, air, and catalyst flows in the several types of fluid catalytic cracking systems is given.

Principle variables affecting the design of a fluid catalyst regeneration system include temperature of regeneration, type of catalyst analysis of catalyst deposit, residence time, and regeneration pressure.

Regeneration temperature in commercial units ranges between 1000° F and 1200° F. Catalyst used affects design and operation of regeneration equipment; and carbon content of sulphur-free deposit varies from about 93 to 87 weight-% and hydrogen content from about 7 to 13 weight-%.

Weight-% of catalyst deposit on spent catalyst charged to regenerator varies between less than 1 to more than 2%. Residence time of catalyst within regenerator ranges between 10 and 20 min in commercial units. Regenerators operate at pressures between 1 and 13 p.s.i.g.

4 tables and 3 figures illustrate the article. G. A. C.

869. Combustion of Coke Deposit on Synthetic Bead Cracking Catalyst. W. A. Hagerbaumer and R. Lee. *Oil Gas J.*, 15.3.47, **45** (45), 76.—The combustion of coke deposits from flowing beds of cracking catalysts has been investigated. Major process variables, affecting the rate of carbon burning were found to be oxygen concentration, temperature, and the concentration and distribution of carbon on the catalyst particles. Graphical methods have been used to correlate the effects of these variables. Tables show physical properties of bead catalyst and typical operating data for T.C.C. kiln regenerating bead catalyst. The correlated data have been applied successfully in designing kilns for commercial T.C.C. units.

The article is illustrated by 11 figures. G. A. C.

Polymerization.

870. Manufacture of Synthetic Gasoline Nearing Commercial Application in U.S. G. Roberts and J. A. Phinney. *Oil Gas J.*, 15.3.47, **45** (45), 72.—The engineering aspects of commercial synthetic gasoline plants in Germany and of the proposed plants in the United States are reviewed.

One process uses natural gas under pressure, preheated with oxygen, the gases being converted to hydrogen and carbon monoxide. These gases are cooled and enter the synthesis reactor to produce liquifiable hydrocarbons.

Use of aluminium for the process equipment in the oxygen plant presents some unusual problems in the welding of aluminium plate in thicknesses greater than 1 in. The design of the synthesis converters includes provision of adequate cooling surface within the reaction vessel without interference in turbulence, and presents problems. One design calls for a vessel of approximately 3400 cu. ft. volume to produce 1000 brls of synthetic oil daily.

Fractionating and recovery equipment is mostly conventional. G. A. C.

Chemical and Physical Refining.

871. Technology, Operation, and Results from Linde Copper Sweetening Process. G. L. Mann. *Oil Gas J.*, 22.3.47, **45** (46), 195.—The process for oxidizing mercaptans in light distillates by means of copper chloride and molecular oxygen is described and two methods for removing all traces of copper compounds from the treated hydrocarbons are discussed.

The process has been in use many years and possesses advantages over the doctor sweetening method. Oxygen is added to a copper chloride–clay–water slurry to regenerate the chloride reagent continuously. 0·10 cu. ft. of oxygen is added for each 0·01% of mercaptan sulphur in the distillate, per brl of distillate processed. Advantages of the process lie in T.E.L. savings, higher quality products, lower operating costs, and elimination of material losses.

Typical installations include those at Socony-Vacuum Oil Co.'s Augusta, Kán. refinery and the Cities Service Oil Co.'s refinery at East Chicago, Ind. G. A. C.

Speciaf Processes.

872. The Catarole Process. II. F. Kind. *Times Rev. Ind.*, 1947, Apr., 21.—The first plant (at Partington, near Manchester) will deal with 50,000 tons p.a. of charging stock; an additional capital expenditure of 25% would increase this to 100–120,000. The capital investment at present represents £2700 for each of the 700 employees, and the increase in value of the raw material is over £3000 per head. The development of new industries using products of the Catarole process, and their place in the national economy, is discussed. V. B.

873. Production of Chemicals from Petroleum. Anon. *Engineering*, 28.3.47, **163**, 248.—A general description is given of a proposed plant to be built in Cheshire for the manufacture of ketones, alcohols, ethers, solvents, and other chemicals by cracking petroleum at temperatures up to 700° C. Initial production is estimated at 24,000 tons p.a. Existing chemical plants at Stanlow and Shell Haven are to be extended: the former is engaged on the manufacture of sodium higher alkyl sulphates and the latter produces insecticides, fungicides, and other agricultural products. Brief particulars of various applications of some of the chemicals produced in these plants are given. G. P. K.

874. Emulsifiers. F. Appell. *Chim. et Ind.*, 1947, **57**, 241–249.—This first part of an illustrated review of the published literature (chiefly patents) on mechanical industrial emulsifiers deals with the production of emulsions by agitation, injection, and grinding. In addition to mechanical agitation some details are given regarding ultrasonic emulsification. Emulsifiers depending on a grinding action are divided into colloid mills and homogenizers, which latter, together with further types of emulsifiers, are to be considered in a subsequent instalment. V. B.

875. Some Notes on Methane Conversion and Ancilliary Processes. Anon. *Rev. Inst. Franç. Petrole*, 1947, **2**, 38–48.—This is an extract from a French report on German industry. The processing of methane is considered from the standpoint of its conversion into synthesis gas and into acetylene, the latter being used as a source of acetone. The purification of methane and the catalysts used in its conversion are described and the yields of products, in various modifications of the process, are given in tabular form. Mention is made of a few control instruments, including those operating on physical principles (absorption in the infra-red and the paramagnetism of oxygen). The purpose of the article is to indicate the scope of the fuller information contained in the records of the French Oil Mission to Germany in 1945–46. V. B.

Refining Patents.

876. Patents on Refining Processes and Products. C. Arnold, assr to S.O. Dev. Co. B.P. 584,386, 29.1.47. Shale distillation process.

Standard Oil Development Co. B.P. 584,428, 29.1.47. Polymerization of hydrocarbons.

J. C. Arnold and S.O. Dev. Co. B.P. 584,557, 29.1.47. Cutting oils.

H. G. C. Fairweather (Air Reduction Co., Inc.). B.P. 584,601, 29.1.47. Production of butadiene.

Gas Research Board, F. J. Dent, and L. A. Moignard. B.P. 584,393, 29.1.47. Method of conducting catalytic gas reactions and apparatus therefore.

National Oil Products Co. B.P. 584,500, 29.1.47. Detergents.

S.O. Dev. Co. B.P. 584,370, 29.1.47. Process and apparatus for the manufacture of aluminium greases.

S.O. Dev Co. B.P. 584,426, 29.1.47. Catalytic polymerization of mono-olefins.

J. C. Arnold (S.O. Dev. Co.). B.P. 584,800, 5.2.47. Production of addition agents for lubricants.

J. C. Arnold (S.O. Dev. Co.). B.P. 584,876, 5.2.47. Apparatus for the countercurrent treatment of liquids.

J. C. Arnold (S.O. Dev. Co.). B.P. 584,892, 5.2.47. Process and apparatus for the countercurrent contacting of liquids of different gravities.

J. G. Fife (Shell Dev. Co.). B.P. 584,746, 5.2.47. Process for the catalytic conversion of hydrocarbons.

Du Pont de Nemours & Co. B.P. 584,794–5, 5.2.47. Manufacture of polymers and interpolymers of ethylene and other olefines.

S.O. Dev. Co. B.P. 584,850, 5.2.47. Lubricating grease composition.

J. C. Arnold (S.O. Dev. Co.). B.P. 585,076, 12.2.47. Production of *m*-xylene.

J. C. Arnold (S.O. Dev. Co.). B.P. 585,211, 12.2.47. Separation of diolefins from mixtures with other hydrocarbons.

J. C. Arnold (S.O. Dev. Co.). B.P. 585,213, 12.2.47. Surface coating compositions and containers lined therewith.

J. C. Arnold (S.O. Dev. Co.). B.P. 585,238, 12.2.47. Lead alkyl compounds.

E. Mandel, H. Steiner, and S. Whincup. B.P. 585,166, 12.2.47. Separation of aromatic hydrocarbons having conjugated unsaturated side groups from their mixtures with other aromatic hydrocarbons.

C. Arnold (S.O. Dev. Co.). B.P. 585,420 and B.P. 585,434, 12.3.47. Catalytic polymerization processes.

J. C. Arnold (S.O. Dev. Co.). B.P. 585,435, 12.3.47. Catalytic polymerization of olefines.

J. C. Arnold (S.O. Dev. Co.). B.P. 585,497, 12.3.47. Production of aviation gasoline.

E. P. Newton (International Bitumen Emulsion Corpn.). B.P. 585,319, 12.3.47. Manufacture of bitumen emulsions.

Shell Dev. Co. B.P. 585,339, 12.3.47. Manufacture of aviation fuels.

S. O. Dev. Co. B.P. 585,352, 12.3.47. Production of motor fuel and aromatic hydrocarbons from oils *ex* the Fischer synthesis.

J. C. Arnold (S.O. Dev. Co.). B.P. 585,578, 12.3.47. Purification of aromatic hydrocarbons.

S. C. Johansson. B.P. 585,643, 12.3.47. Lub. oils, fuel oils, and gasolines.

Standard Oil Dev. Co. B.P. 585,571, 12.3.47. Catalytic treatment of hydrocarbons.

C. Arnold (S.O. Dev. Co.). B.P. 585,735, 19.3.47. Foam inhibiting agents.

J. C. Arnold (S.O. Dev. Co.). B.P. 585,702, 19.3.47. Application of lubricants to bearings.

J. G. Fife (Shell Dev. Co.). B.P. 585,742, 19.3.47. Process and catalyst for the conversion of hydrocarbons.

Anglo-Iranian Oil Co., S. F. Birch, J. Habeshaw, and C. B. Collis. B.P. 585,850, 19.3.47. Production of *cyclo*hexane and benzene from petroleum naphtha or other feed stocks.

C. Arnold (S.O. Dev. Co.). B.P. 585,803, 19.3.47. Addition agents for mineral lub. oils.

C. Arnold (S.O. Dev. Co.). B.P. 585,923, 19.3.47. Lube oil compositions.

C. Arnold (S.O. Dev. Co.). B.P. 585,931, 19.3.47. An alkylation process.

J. C. Arnold (S.O. Dev. Co.). B.P. 585,872, 19.3.47. Addition agents for E.P. lubricants.

I.C.I. and D. H. P. Peel. B.P. 585,958, 19.3.47. Dehydrogenation of naphthenes to aromatic hydrocarbons.

Trinidad Leaseholds and E. Hene. B.P. 585,808, 19.3.47. Condensation products.

C. Arnold (S.O. Dev. Co.). B.P. 586,130, 26.3.47. Manufacture of soap-thickened petroleum distillate compositions.

C. Arnold (S.O. Dev. Co.). B.P. 586,161, 26.3.47. Production of aviation fuels.

Distillers Co. and A. J. V. Underwood. B.P. 586,027, 26.3.47. Method of carrying out cracking, pyrolysis, and partial oxidation reactions.

H. Schou. B.P. 586,109, 26.3.47. Manufacture of thermally stable water-in-oil dispersions.

S. O. Dev. Co. B.P. 585,990, 26.3.47. Method and apparatus for catalytic hydrocarbon conversion reactions.

J. C. Arnold (S.O. Dev. Co.). B.P. 586,333, 26.3.47. Anti-oxidants for lub. oils.

Kodak Ltd. B.P. 586,368, 26.3.47. Stabilizing motor fuels.

J. C. Arnold (S.O. Dev. Co.). B.P. 586,473, 2.4.47. Process for *iso*-olefin-diolefin interpolymers.

J. C. Arnold (S.O. Dev. Co.). B.P. 586,474, 2.4.47. Separation of hydrocarbon mixtures.

J. C. Arnold (S.O. Dev. Co.). B.P. 586,483, 2.4.47. Process for the conversion of gaseous olefins to liquid hydrocarbons.

I.C.I. and F. J. L. Bentley. B.P. 586,494, 2.4.47. Alumina catalysts.

N. V. de Bataaf. Pet Mitj, W. C. Webber, R. S. Airs, and T. P. Hughes. B.P. 586,461, 2.4.47. Lub. oil compositions.

S. O. Dev. Co. B.P. 586,512, 2.4.47. Manufacture of hydrocarbon oil compositions.

C. Arnold (S.O. Dev. Co.). B.P. 586,609, 10.4.47. Adhesive polymeric materials.

C. Arnold (S.O. Dev. Co.). B.P. 586,669, 10.4.47. Coating compositions for the prevention of corrosion.

J. C. Arnold (S.O. Dev. Co.). B.P. 586,716, 10.4.47. Process for the production of synthetic rubber-like materials.

J. C. Arnold (S.O. Dev. Co.). B.P. 586,697, 10.4.47. Catalytic alkylation of *iso*-paraffins with olefins.

I.C.I. and A. E. Rout. B.P. 586,732, 10.4.47. Nitration of aromatic hydrocarbons.

B. V. de Bataaf Petr. Mij and D. H. Japes. B.P. 586,679, 10.4.47. Anticorrosion oils.

Shell Dev. Co. B.P. 586,754, 10.4.47. Catalytic oxidation of ketones.

S. O. Dev. Co. and C. Arnold. B.P. 586,615, 10.4.47. Separation of acetylene from mixtures.

L. Wickenden. B.P. 586,766, 10.4.47. Treatment of waste oil refinery sludge coke.

R. E. Burk and E. C. Hughes, assrs to S.O.C. Ohio. U.S.P. 2,405,184, 6.8.46. The catalytic conversion of non-benzenoid hydrocarbons to aromatics at 850° to 1100° F in the presence of hydrogen.

G. R. Lake, assr to Union Oil Co. U.S.P. 2,405,258, 6.8.46. Azeotropic distillation using acetone to separate thiophane from thiophene.

R. B. Greenburg, assr to Allied Chemical and Dye Corpn. U.S.P. 2,405,300, 6.8.46. Non-aromatic hydrocarbons are removed from xylene concentrates by azeotropic distillation with ethylene diamine.

H. R. Markley, assr to Phillips Petroleum Co. U.S.P. 2,405,364, 6.8.46. A process and apparatus for the catalytic vapour phase isomerization of *n*-butane.

I. L. Wolk, assr to Phillips Petroleum Co. U.S.P. 2,405,386, 6.8.46. Catalytic isomerization of *n*-butane.

G. T. Atkins, Jr., assr to S.O. Dev. Co. U.S.P. 2,405,393, 6.8.46. An improved form of batch fractional distillation.

W. H. Bahlke and M. T. Carpenter, assrs to S.O.C. Indiana. U.S.P. 2,405,395, 6.8.46. The catalytic conversion of hydrocarbons to acetylene at 1800° F.

G. C. Connolly, assr to S.O. Dev. Co. U.S.P. 2,405,408, 6.8.46. Method of preparing a metal oxide–silica gel for use as a cracking catalyst.

K. C. Laughlin, assr to S.O. Dev. Co. U.S.P. 2,405,436, 6.8.46. Catalytic dehydrogenation of hydrocarbons in the presence of steam to retain the activity of the catalyst.

E. J. Martin assr to General Motors Corpn. U.S.P. 2,405,441, 6.8.46. Isomerization of an olefin at 150° to 700° F in the presence of a sulphide of nickel or tungsten.

J. C. Zimmer and A. J. Morway, assrs to S.O. Dev. Co. U.S.P. 2,405,482, 6.8.46. Chlorinated paraffin wax is reacted with 2–5% by wt phosphorus sesquisulphide at 250–370° F.

J. A. Chenicek and R. B. Thompson, assrs to U.O.P. Co. U.S.P. 2,405,490, 6.8.46. Two-stage olefin alkylation of an isoparaffin using $AlCl_3$.

H. Pines, assr to U.O.P. Co. U.S.P. 2,405,516, 6.8.46. Isomerization of a hydrocarbon with $AlCl_3$ in the presence of a monocyclic aromatic hydrocarbon containing more than 8 carbon atoms.

J. M. Campbell, assr to General Motors Corpn. U.S.P. 2,405,560, 13.8.46. About 0·1% tributyl phosphite is added to a leaded-gasoline.

E. W. M. Fawcett and G. I. Jenkins, assrs to A.I.O.C. U.S.P. 2,405,565, 13.8.46. A two-stage isomerization cum alkylation of normal paraffins using a halide catalyst.

D. T. Rogers, assr to S.O. Dev. Co. U.S.P. 2,405,607–8, 13.8.46. A stabilizer for lub. oil is obtained by the reaction between a phosphorus sulphide and the product obtained by the action of a phenol on the sulphur chloride derivative of an olefin.

N. F. Linn, assr to S.O. Dev. Co. U.S.P. 2,405,660, 13.8.46. Pure toluene is obtained by a multistage treatment of the product from the hydrogenation of carbon monoxide, including distillation, catalytic cracking, catalytic reforming, and solvent extraction.

M. de Groote and B. Keiser, assrs to Petrolite Corpn. U.S.P. 2,405,737, 13.8.46. Manufacture of water soluble surface active agents, such as the sulpho succinates.

W. E. Bradley, assr to Union Oil Co. U.S.P. 2,405,775, 13.8.46. A substantially pure *iso*paraffinic oil of boiling range 350° to 800° F is used as an insecticide and fungicide.

G. W. Ayers and D. M. Barton, assrs to The Pure Oil Co. U.S.P. 2,405,872, 13.8.46. Oils are treated with an aqueous solution containing 5% free caustic soda and a sufficient amount of the soluble reaction product of an alkali and high b.p. tar acids to extract weakly acid sulphur compounds.

E. F. Bullard, J. Anderson, and S. H. McAllister, assrs to Shell Dev. Co. U.S.P. 2,405,874, 13.8.46. An aromatic hydrocarbon is alkylated under 250 lb pressure in the presence of a solid catalyst.

H. Schindler, assr to The Pure Oil Co. U.S.P. 2,405,905, 13.8.46. An olefinic C_4 cut is polymerized with 65–70% sulphuric acid at 20–45° C under liquid phase conditions. The polymer is desulphurized by contact with a siliceous solid adsorbent.

H. Schindler and L. M. Henderson, assrs to The Pure Oil Co. U.S.P. 2,405,906, 13.8.46. An oxidation and rust inhibitor for turbine oils is extracted from spent caustic solution obtained in treating gasoline containing phenolic and sulphur compounds.

J. B. Wyman and H. D. Loeb, assrs to Shell Dev. Co. U.S.P. 2,405,922, 13.8.46. A method of bringing on stream a fluid catalyst cracking unit.

J. A. Anderson, Jr., assr to S.O. Dev. Co. U.S.P. 2,405,935, 20.8.46. Aromatics are obtained by subjecting the 150–350° F cut of a cracked gasoline to thermal cracking and hydroforming.

W. F. Gresham, assr to Du Pont de Nemours & Co. U.S.P. 2,405,948, 20.8.46. Dihaloalkanes are obtained by the action of hydrochloric acid and formaldehyde in propylene.

W. E. Hanford, assr to Du Pont de Nemours & Co. U.S.P. 2,405,950, 20.8.46. Gaseous olefins are polymerized in the presence of a catalyst selected from the class of hydrazine compounds.

P. E. Kuhl and R. M. Shepardson, assrs to S.O. Dev. Co. U.S.P. 2,405,959, 20.8.46. Super Filtrol is used as a cracking catalyst.

C. S. Lynch and H. G. Codet, assrs to S.O. Dev. Co. U.S.P. 2,405,968, 20.8.46. The alkylation of ethylene with *iso*butane using $AlCl_3$ as catalyst.

R. E. Burk, assr to S.O.C. Ohio, U.S.P. 2,405,993–7, 20.8.46. Boron trifluoride–hydrofluoric acid catalyst is employed to "average" C_5 cuts and *iso*pentane, propane, and pentane, and de-aromatizing and modifying hydrocarbon mixtures.

J. T. Dickinson and A. R. Moorman, assrs to S.O.C. Indiana. U.S.P. 2,406,065, 20.8.46. A continuous disc filter.

W. A. La Lande, Jr., and H. Heinemann, assrs to Porocel Corpn. U.S.P. 2,406,081, 20.8.46. Olefins are polymerized with the aid of activated bauxite.

C. B. Linn, assr to U.O.P. Co. U.S.P. 2,406,086, 20.8.46. Hydrofluoric acid containing hydrogen cyanide is used as an alkylation catalyst.

L. Schmerling, assr to U.O.P. Co. U.S.P. 2,406,110, 20.8.46. Branched-chain paraffins are obtained by hydrogenation of the reaction product from the treatment of a mono-olefin with a methyl halide in the presence of lead oxide.

W. A. Schulze, assr to Phillips Petroleum Co. U.S.P. 2,406,112, 20.8.46. A catalytic cracking process in which steam is injected into the charging stock and a water resistant contact catalyst is employed.

A. B. Welty, Jr., assr to S.O. Dev. Co. U.S.P. 2,406,117, 20.8.46. A catalytic reforming process employing free hydrogen.

C. D. Cantrell, Jr., assr to Phillips Petroleum Co. U.S.P. 2,406,192, 20.8.46. A sampling apparatus for liquid hydrocarbons.

O. W. Cass, assr to Du Pont de Nemours & Co. U.S.P. 2,406,195, 20.8.46. Preparation of the higher chlorides of methane.

R. M. Cole, assr to Shell Dev. Co. U.S.P. 2,406,200, 20.8.46. A conditioned heavy metal sulphide catalyst is employed in the hydrogenation of sulphur containing hydrocarbon oils.

S. W. Ferris, assr to The Atlantic Refining Co. U.S.P. 2,406,210, 20.8.46. A method of controlling the sweating of wax by employing a melting point–refractive index chart.

J. C. Marancik and R. F. Mildrum, assrs to S.O. Dev. Co. U.S.P. 2,406,234, 20.8.46. An expansion joint for pipe conveying fluid carrying injurious materials, such as suspended solids and corrosive materials.

J. M. Barron, assr to The Texas Co. U.S.P. 2,406,312–3, 27.8.46. A combination thermal cracking and coking process.

D. E. Badertscher, H. G. Berger, and R. B. Bishop, assrs to Socony-Vacuum Oil Co. U.S.P. 2,406,339, 27.8.46. Hydrogen fluoride is used as a catalyst in making light-coloured resins by the phenol–formaldehyde reaction.

W. N. Hoyte, assr to Foster Wheeler Corpn. U.S.P. 2,406,375, 27.8.46. A fractionating column.

R. H. Newton, assr to Houdry Process Corpn. U.S.P. 2,406,394, 27.8.46. Narrow-cut gasoline fractions are subjected to catalytic cracking and blended to give aviation gasoline.

H. B. Weiser, E. A. Smith, and J. S. Mackay, assrs to Houdry Process Corpn. U.S.P. 2,406,420, 27.8.46. Manufacture of stable alumina and alumina–molybdenum oxide catalysts.

E. Solomon and L. C. Rubin, assrs to The M. W. Kellogg Co. U.S.P. 2,406,477, 27.8.46. Manufacture of an $AlCl_3$ catalyst.

E. R. Johnson, assr to Texaco Dev. Co. U.S.P. 2,406,544, 27.8.46. Iron pentacarbonyl is used as an antiknock agent in an aviation fuel.

P. E. Kuhl and A. B. Welty, Jr., assrs to S.O. Dev. Co. U.S.P. 2,406,547, 27.8.46. A modified catalytic cracking process.

E. Lieber, assr to S.O. Dev. Co. U.S.P. 2,406,549, 27.8.46. A pour-point depressant is obtained as a product of a Friedel–Crafts condensation of an aromatic compound and a saturated ester.

H. Z. Martin, assr to S.O. Dev. Co. U.S.P. 2,406,555, 27.8.46. A catalytic cracking process for residual oils.

D. T. Rogers and J. G. McNab, assr to S.O. Dev. Co. U.S.P. 2,406,564, 27.8.46. A lub. oil additive is obtained by reacting sulphur with a metal phenate.

D. W. Young and H. D. Hineline, assrs to S.O. Dev. Co. U.S.P. 2,406,575, 27.8.46. A lub. oil additive is obtained by treating a cyclicized polymer of a polyolefin with phosphorus pentasulphide.

E. C. Lee and C. L. Thomas, assrs to U.O.P. Co. U.S.P. 2,406,613–4, 27.8.46. A composite silica–alumina–zirconia catalyst is used in conversion of hydrocarbons.

J. M. Mavitz, assr to U.O.P. Co. U.S.P. 406,622, 27.8.46. In a hydrocarbon isomerization process a metal is incorporated in the aluminium halide catalyst to prevent the formation of a hydrocarbon–aluminium halide complex in the catalyst bed.

H. Pines and V. N. Ipatieff, assrs to U.O.P. Co. U.S.P. 2,406,620–2, 27.8.46. Methods of preparing *cyclo*-olefinic and aromatic hydrocarbons involving the use of glycol, mono-olefins, and monohydric alcohols.

L. Schmerling and V. N. Ipatieff, assrs to U.O.P. Co. U.S.P. 2,406,639, 27.8.46. An alkoxy aluminium halide catalyst is used in the conversion of hydrocarbons.

P. Siecke, assr to Gulf Oil Corpn. U.S.P. 2,406,640, 27.8.46. A thermal cracking process employing high rates of heat input and avoiding excessive coke formation.

C. L. Thomas, assr to U.O.P. Co. U.S.P. 2,406,645, 27.8.46. A thermal reaction between an olefin and a polynuclear aromatic compound.

G. M. Webb and M. A. Smith, assrs to U.O.P. Co. U.S.P. 2,406,646, 27.8.46. Manufacture of alumina catalysts.

A. R. Bax, H. F. Kielhorn, and W. E. Forney, assrs to Cities Service Oil Co. U.S.P. 2,406,655, 27.8.46. A process for the manufacture of lithium-base greases.

L. A. Clarke, assr to The Texas Co. U.S.P. 2,406,667, 27.8.46. An aviation fuel which includes 2 : 3-dimethylbutane as a component.

H. Diamond, assr to Shell Dev. Co. U.S.P. 2,406,671, 27.8.46. A cutting oil which contains an organo silicon compound as a foam-reducing agent.

N. B. Haskell, assr to The Texas Co. U.S.P. 2,406,681, 27.8.46. A butane isomerization process.

A. W. Horton and J. Kellett, III, assrs to Socony Vacuum Oil Co. U.S.P. 2,406,688, 27.8.46. 2 : 3-Dimethylbutenes are obtained by passage of neohexane over a chromium oxide catalyst at 800–1200° F.

G. R. Lake, assr to Union Oil Co. U.S.P. 2,406,695, 27.8.46. In distilling narrow cut hydrocarbon mixtures an aliphatic ketone is employed to separate one component as a distillate while simultaneously using a phenolic compound to retain a second component in the residue.

E. F. Pevere, assr to The Texas Co. U.S.P. 2,406,709, 27.8.46. Isobutane is alkylated with ethylene using $AlCl_3$ catalyst under conditions that give an alkylate containing neohexane.

N. L. Dickinson, assr to S.O.C. Indiana. U.S.P. 2,406,748, 3.9.46. A method and apparatus for desalting reduced crude by means of liquid propane.

W. K. Griesinger, assr to The Atlantic Refining Co. U.S.P. 2,406,763, 3.9.46. A method of purifying oil soluble petroleum sulphonates containing inorganic salts and water.

J. B. Kirkpatrick, J. J. Somers, and A. N. Sachanen, assrs to Socony-Vacuum Oil Co. U.S.P. 2,406,776, 3.9.46. An improved form of the alkylation process.

W. E. Kruse, C. W. Nysewander, and J. A. Bolt, assrs to S.O.C. Indiana. U.S.P. 2,406,778, 3.9.46. The isomerization of C_4–C_6 paraffins with particular reference to the use of $AlCl_3$ slurry.

R. B. Day, assr to U.O.P. Co. U.S.P. 2,406,810, 3.9.46. A method of distilling volatile hydrocarbons from hydrocarbon solids in a retort.

J. E. Fratis and E. H. Oakley, assrs to American Bitumals Co. U.S.P. 2,406,823, 3.9.46. High mol wt petroleum acids are added to an asphalt to render it emulsifiable with caustic soda.

A. K. Redcay, assr to Standard Catalytic Co. U.S.P. 2,406,851, 3.9.46. Improvements in the Fischer synthesis.

C. L. Thomas, assr to U.O.P. Co. U.S.P. 2,406,864, 3.9.46. A compound catalyst is employed to increase the antiknock value of the Fischer synthesized hydrocarbons as they are formed.

C. O. Jongberg and H. J. Hall, assrs to S.O. Dev. Co. U.S.P. 2,406,868, 3.9.46. A small amount of a naphthene is employed in the isomerization of *n*-butane.

J. D. Upham, assrs to Phillips Petroleum Co. U.S.P. 2,406,869, 3.9.46. Manufacture of the Friedel–Crafts catalyst.

A. C. Mohr, assr to Chemical Construction Corpn. U.S.P. 2,406,890, 3.9.46. The production of sulphur dioxide from alkylation sludge.

J. W. Teter, assr to Sinclair Refining Co. U.S.P. 2,406,929, 3.9.46. An amination catalyst comprising about 40–60% cobalt in suspension on a carrier of hydrated magnesium silicate.

C. B. Linn, assr to U.O.P. Co. U.S.P. 2,406,954, 3.9.46. Hydrofluoric acid containing a selected fluoride or oxyfluoride is used as a catalyst in the alkylation of an *iso*paraffin.

H. Pines, assr to U.O.P. Co. U.S.P. 2,406,967, 3.9.46. Isomerization of a liquid paraffin in the presence of a polynuclear aromatic.

A. A. O'Kelly, J. Plucker, and R. W. Work, assrs to Socony-Vacuum Oil Co. U.S.P. 2,407,033, 3.9.46. Catalytic alkylation of a paraffin at 590–850° F at pressures up to 500 p.s.i. in the presence of an organic cyclic oxygen compound.

W. A. Bailey, Jr., and B. S. Greensfelder, assrs to Shell Dev. Co. U.S.P. 2,407,052, 3.9.46. Two-stage catalytic cracking to produce high octane gasoline.

E. Lieber and A. F. Cashman, assrs to S.O. Dev. Co. U.S.P. 2,407,087, 3.9.46. An auto-condensation of an aliphatic ketone is used as a pour-point depressant.

L. A. Clarke, assr to The Texas Co. U.S.P. 2,407,136–7, 3.9.46. A method and apparatus for continuous alkylation.

S. F. Birch, F. A. Fidler, and L. S. Thornes, assrs to A.I.O.C. U.S.P. 2,407,214, 10.9.46. Production of *cyclo*pentane from the forerunnings of coal-tar benzol by polymerization, distillation, depolymerizing, and hydrogenation.

L. S. Galstaun, assr to Tide Water Associated Oil Co. U.S.P. 2,407,231, 10.9.46. Removal of moisture in the process of isomerization.

C. S. Lynch and H. G. Codet, assrs to S.O. Dev. Co. U.S.P. 2,407,311, 10.9.46. Improvements in the alkylation of ethylene with an *iso*paraffin.

C. R. Clark, assr to Allied Chemical and Dye Corpn. U.S.P. 2,407,364, 10.9.46. An ether of ethylene glycol is used in the azeotropic distillation of the appropriate hydrocarbon fraction to separate pure toluene.

K. K. Kearly, assr to S.O. Dev. Co. U.S.P. 2,407,373, 10.9.46. A process for the catalytic dehydrogenation of butene to butadiene.

H. W. Scheeline, assr to S.O. Dev. Co. U.S.P. 2,407,386, 10.9.46. Improvements in the separation and concentration of a secondary olefin from a hydrocarbon mixture using 75–90% sulphuric acid.

C. H. Watkins, assr to S.O. Dev. Co. U.S.P. 2,407,390, 10.9.46. The alkylation of propylene with *iso*butane.

G. E. Jodell, assr to Electroflux Pty, Ltd. U.S.P. 2,407,426, 10.9.46. A wick-type kerosine burner for use in refrigerators.

J. F. T. Blott and P. Alexander, assrs to Shell Dev. Co. U.S.P. 2,407,470, 10.9.46. Preparation of bitumen compositions containing mineral aggregates having improved load-bearing capacities.

L. G. Hall and H. G. Boucher, assrs to Shell Dev. Co. U.S.P. 2,407,492, 10.9.46. A combination thermal cracking and hydro-refining process to produce gasoline.

W. A. Stover, assr to Socony Vacuum Oil Co. U.S.P. 2,407,584–5, 10.9.46. Alkylation of a paraffin in the presence of the carbon dioxide with or without admixture of water.

E. W. M. Fawcett, assr to A.I.O.C. U.S.P. 2,407,637, 17.9.46. Production in the vapour phase of branch chained paraffins by isomerization.

L. C. Huff, assr to U.O.P. Co. U.S.P. 2,407,700, 17.9.46. A simplified apparatus for catalytic cracking.

R. F. Marschner, assr to S.O.C. Indiana. U.S.P. 2,407,716–7, 17.9.46. A super-aviation fuel consisting of (i) *cyclo*pentane and neohexane, (ii) *iso*octane and 1 : 1 : 2-trimethyl*cyclo*propane.

R. F. Marschner and D. R. Carmody, assrs to S.O.C. Indiana. U.S.P. 2,407,718, 17.9.46. A super-aviation fuel consisting of *iso*octane and an azeotropic mixture of di*iso*propyl and acetone.

J. H. Perrine and H. L. Johnson, assrs to Sun Oil Co. U.S.P. 2,407,766, 17.9.46. An acidic product from oxidized lub. oil is used in alkyd resin manufacture.

H. A. Cheney, assr to Shell Dev. Co. U.S.P. 2,407,813–4, 17.9.46. Manufacture of cobalt and nickel catalysts.

A. V. Danner, assr to Socony-Vacuum Oil Co. U.S.P. 2,407,817, 17.9.46. A combined catalytic cracking and refining process.

E. L. Durrum, assr to Shell Dev. Co. U.S.P. 2,407,820, 17.9.46. A combination extraction and azeotropic distillation process to separate aromatic hydrocarbons.

F. E. Frey and R. D. Snow, assrs to Phillips Petroleum Co. U.S.P. 2,407,825, 17.9.46. A continuous process of separating conjugated diolefins from the corresponding olefins and paraffins using the sulphone reaction in the distillation column.

E. Gorin, assr to Socony Vacuum Oil Co. U.S.P. 2,407,828, 17.9.46. Production of aliphatic chlorides using aliphatic hydrocarbons and hydrogen chloride in contact with cuprous chloride.

G. C. Ray, assr to Phillips Petroleum Co. U.S.P. 2,407,848, 17.9.46. Production of acrylonitrile by a catalytic process.

I. L. Wolk, assr to Phillips Petroleum Co. U.S.P. 2,407,861, 17.9.46. An oxidation inhibitor is introduced in the fractionating zone in the distillation of a readily polymerizable organic compound.

B. L. Evering, E. L. d'Ouville, and D. R. Carmody, assrs to S.O.C. Indiana. U.S.P. 2,407,873, 17.9.46. Polymerization of olefins using $AlCl_3$ as catalyst.

W. A. Bailey, Jr., and J. Burgin, assrs to Shell Dev. Co. U.S.P. 2,407,914, 17.9.46. Preparation of boric oxide–alumina catalyst and its use in catalytic cracking.

J. Burgin, assr to Shell Dev. Co. U.S.P. 2,407,918, 17.9.46. A catalytic cracking process using boric oxide admixed with an inert carrier as catalyst.

M. R. Fenske and G. H. Cummings, assrs to Rohm and Haas Co. U.S.P. 2,407,954, 17.9.46. An oil-soluble polymerized ester is used as a lube oil additive.

J. A. Patterson, assr to S.O. Dev. Co. U.S.P. 2,407,997, 24.9.46. Isoprene is separated from cracked stocks by azeotropic distillation with aqueous acetone then extractive distillation with acetone then fractional distillation.

E. F. Wadley and J. T. Horeczy, assrs to S.O. Dev. Co. U.S.P. 2,408,010, 24.9.46. Ethylene is separated from propylene by scrubbing their mixture with a boron fluoride–sulphuric acid catalyst under conditions in which the propylene is selectively polymerized.

D. C. Walsh, Jr., and E. Q. Camp, assrs to S.O. Dev. Co. U.S.P. 2,408,011, 24.9.46. To prevent corrosion during distillation an alkali metal salt of a phenol is added to an acid treated oil.

S. Musher, assr to Musher Foundation Inc. U.S.P. 2,408,090, 24.9.46. A phosphatide and a mononuclear aromatic sulphur compound are added to lub. oil to retard sludge formation.

H. G. Smith, T. L. Cantrell, and J. G. Peters, assrs to Gulf Oil Corpn. U.S.P. 2,408,102–3, 24.9.46. An oil-soluble trivalent metal salt of *N*-alkylol *o*-phthalamidic acid is used as a corrosion inhibitor for lube oil.

A. Voorhees, Jr., assr to S.O. Dev. Co. U.S.P. 2,408,131, 24.9.46. Aluminium oxide–chromium oxide–nickel oxide catalyst is used in the dehydrogenation of low-boiling hydrocarbons.

C. L. Gutzeit, assr to Shell Dev. Co. U.S.P. 2,408,139–40, 24.9.46. In the dehydrogenation of a mono-olefin to a diolefin the catalyst employed as iron oxide admixed with potassium oxide and bismuth oxide or chromium oxide, in the presence of steam.

K. K. Kearly, assr to Jasco Inc. U.S.P. 2,408,146, 24.9.46. Mono-olefins are dehydrogenated to diolefins in the presence of steam using magnesium oxide–chromium oxide–alkaline oxide catalyst.

A. L. Foster, assr to Phillips Petroleum Co. U.S.P. 2,408,164, 24.9.46. Preparation of $CaCl_2$–$AlCl_3$ catalyst.

H. J. Hepp, assr to Phillips Petroleum Co. U.S.P. 2,408,167, 24.9.46. Alkylation of an aromatic with an olefin employing a silica–metal oxide catalyst.

M. P. Matuszak, assr to Phillips Petroleum Co. U.S.P. 2,408,173, 24.9.46. Alkylation of an aromatic employing hydrofluoric acid as catalyst.

H. V. Atwell and H. H. Gross, assrs to The Texas Co. U.S.P. 2,408,186, 24.9.46. An isomerization process using $AlCl_3$ catalyst.

H. V. Atwell, assr to The Texas Co. U.S.P. 2,408,187, 24.9.46. Manufacture of an $AlCl_3$–kerosine complex for use as a catalyst.

A. D. Garrison and K. C. Ven Brink, assrs to Texaco Dev. Corpn. U.S.P. 2,408,207, 24.9.46. Treatment of montmorillonite clay to improve its adsorptive characteristics.

G. H. Keating, assr to The Texas Co. U.S.P. 2,408,215, 24.9.46. Manufacture of alumina–silica gel catalyst.

H. G. Smith and T. L. Cantrill, assr to Gulf Oil Corpn. U.S.P. 2,408,232, 24.9.46. Manufacture of an aromatic amine salt of 3-methyl-butyl 2-ethyl-hexyl orthophosphate.

S. C. Carney, assr to Phillips Petroleum Co. U.S.P. 2,408,294, 24.9.46. Conversion of hydrocarbons using $AlCl_3$ as catalyst and recovering the latter by extraction with $SbCl_3$.

R. H. Cubberley and F. W. Yeager, assrs to The Patent and Licensing Corpn. U.S.P. 2,408,297, 24.9.46. A bituminous composition of a flexible nature is obtained by mixing solid asphalt, cetylacetamide wax, and poly*iso*butylene.

J. R. Meadow, assr to Socony-Vacuum Oil Co. U.S.P. 2,408,329, 24.9.46. In the HF alkylation of a paraffin a halogen is introduced into the reaction zone.

E. L. Flood, assr to Consolidated Vultee Aircraft Corpn. U.S.P. 2,408,385, 1.10.46. A drill lubricant comprising soda-base grease, paraffin wax, turpentine, and aluminium stearate.

H. S. Bloch, assr to U.O.P. Co. U.S.P. 2,408,548, 1.10.46. Conditions for the operation of an $AlCl_3$ isomerization process.

D. Read, Jr., assr to U.O.P. Co. U.S.P. 2,408,580, 1.10.46. A combination thermal and catalytic cracking process for heavy oils.

A. D. Smith, assr to Jenkins Petroleum Process Co. U.S.P. 2,408,584, 1.10.46. Minimization of corrosion in a cracking still is effected by the addition of calcium hydroxide to the incoming charge.

C. H. O. Berg, assr to Union Oil Co. U.S.P. 2,408,600, 1.10.46. A catalytic cracking process in which the charge and catalyst flow is countercurrent.

H. M. Smallwood, assr to U.S. Rubber Co. U.S.P. 2,408,696, 10.1.46. Finely divided hydrogen containing carbon-black is treated with a halogen.

M. M. Sprung, assr to G.E.C. U.S.P. 2,408,700, 10.1.46. A synthetic wax is obtained as the product of the reaction between an aliphatic polyamine and a halogenated aromatic mono-carboxylic acid.

J. C. Bailie and R. V. Shankland, assrs to S.O.C. Indiana. U.S.P. 2,408,724, 8.10.46. Toluene is obtained by cracking a selected naphtha cut in the presence of hydrogen and an alumina–molybdenum oxide catalyst.

A. Belchetz, assr to The M. W. Kellogg Co. U.S.P. 2,408,725, 8.10.46. An alkylation process using sulphuric acid.

R. E. Burk, assr to S.O.C. Ohio. U.S.P. 2,408,752, 8.10.46. A two-stage $AlCl_3$ isomerization process applied to C_5–C_6 normal and slightly branched chain paraffins.

R. E. Burk, assr to S.O.C. Ohio. U.S.P. 2,408,753, 8.10.46. A combination high temperature thermal cracking isomerization and alkylation process to manufacture high-octane gasoline.

R. N. Meinert, assr to S.O. Dev. Co. U.S.P. 2,408,798, 8.10.46. An *iso*paraffin is alkylated with a mixture of different olefins using $AlCl_3$.

S. C. Riecke. U.S.P. 2,408,812, 8.10.46. Design of a machine to wax fruit and vegetables by brushing them with powdered wax.

H. E. Drennan, assr to Phillips Petroleum Co. U.S.P. 2,408,920, 8.10.46. Mercaptans are separated from the crude reaction product of the catalytic addition of hydrogen sulphide to tertiary olefin polymers by the use of a liquid hydrocarbon diluent and caustic soda.

T. W. Evans, R. C. Morris, and E. C. Shokal, assrs to Shell Dev. Co. U.S.P. 2,408,922, 8.10.46. *Iso*Propylamine is used as the azeotropic component in the separation of isoprene by distillation.

J. O. Iverson, assr to U.O.P. Co. U.S.P. 2,408,933, 8.10.46. Recovery of hydrogen fluoride used in alkylation.

J. S. Mahan, assr to Phillips Petroleum Co. U.S.P. 2,408,940, 8.10.46. The ester of a carboxylic acid is obtained by reacting a nitrile and an olefin in the presence of water and a strong acid.

L. A. Mekler, assr to U.O.P. Co. U.S.P. 2,408,943, 8.10.46. A method of regenerating the catalyst after use in a catalytic cracking operation.

H. S. Nutting and L. H. Horsley, assrs to The Dow Chemical Co. U.S.P. 2,408,947, 8.10.46. Ammonia is employed as the azeotropic component in separating by distillation the C_3–C_7 saturated and unsaturated hydrocarbons.

C. L. Ocon and E. A. Ocon. U.S.P. 2,408,948, 8.10.46. The catalytic reforming of low-boiling gasoline in the presence of a hydrogen-bearing gas.

H. Pines and H. S. Bloch, assr to U.O.P. Co. U.S.P. 2,408,950, 8.10.46. Conversion of hydrocarbons in the presence of hydrogen halide and a solid adsorbent.

T. F. Doumani and D. A. Skinner, assrs to Union Oil Co. U.S.P. 2,408,970, 8.10.46. Acetylenes are removed from their mixture with diolefins in the form of oxygen derivatives by treatment with water in the vapour phase in the presence of a catalyst.

G. W. Duncan, assr to S.O. Dev. Co. U.S.P. 2,408,971, 8.10.46. A slushing oil composition.

A. H. Gebauer, assr to Tide Water Associated Oil Co. U.S.P. 2,408,977, 8.10.46. Separation of an oil–wax mixture by a filtration process in which the de-oiled wax is continuously discharged.

M. H. Kollen, assr to Union Oil Co. U.S.P. 2,408,983, 8.10.46. A hydraulic fluid is composed of a major proportion of high boiling *iso*paraffins and a small amount of a high mol wt olefine polymer to change the viscosity index.

M. M. Marisic and A. C. Schmitt, assrs to Socony-Vacuum Oil Co. U.S.P. 2,408,986; 8.10.46. Manufacture of inorganic oxide gel catalysts in the form of beads.

M. P. Matuszak and G. H. Morey, assrs to Phillips Petroleum Co. U.S.P. 2,408,987, 8.10.46. Manufacture of a granular catalyst from an ammonium containing salt of chromic acid.

R. L. Parker, Jr., and H. C. Huffman, assrs to Union Oil Co. U.S.P. 2,408,996, 8.10.46. Regeneration of a spent cracking catalyst.

A. E. Robertson, assr to S.O. Dev. Co. U.S.P. 2,408,999, 8.10.46. A small amount of a gaseous paraffin or naphthene containing 3 to 5 carbon atoms is added to a branched alkanol containing 3 to 5 carbon atoms to produce a motor fuel of suitable vapour pressure.

W. O. Webber, assr to S.O. Dev. Co. U.S.P. 2,409,005, 8.10.46. De-salting of crude oil by water treatment.

J. V. Montgomery, L. B. Goodson, and R. W. Henry, assrs to Phillips Petroleum Co. U.S.P. 2,409,059, 8.10.46. Mineral oils are extracted with a solvent comprising a mixture of a hydrogenated pyridine fraction and acetone.

C. M. Thacker and R. T. Bell, assrs to The Pure Oil Co. U.S.P. 2,409,080, 8.10.46. Benzene is alkylated by reaction with alkyl mercaptans or sulphides in the presence of copper pyrophosphate.

R. E. Woodward, W. P. Hawthorne, and J. R. Meadow, assrs to Socony-Vacuum Oil Co. U.S.P. 2,409,090, 8.10.46. The hydrogen fluoride alkylation of an *iso*paraffin with ethylene.

W. A. Schulze and R. C. Alden, assrs to Phillips Petroleum Co. U.S.P. 2,409,156–7, 8.10.46. A leaded aviation fuel which consists of an *iso*paraffin mixture having 5, 6, 7, 8, and 9 carbon atoms per molecule together with either *iso*propylbenzene or a monobutyl benzene other than the normal isomer.

P. L. Veltman, assr to Texaco Dev. Corpn. U.S.P. 2,409,167, 8.10.46. The product obtained by heating together an olefin and a metal carbonyl is used as an antiknock agent.

P. L. De Verter, assr to S.O. Dev. Co. U.S.P. 2,409,171, 8.10.46. Hydroquinone and quinhydrone are used to inhibit the formation of precipitates in leaded motor fuels.

M. H. Arveson, assr to S.O.C. Indiana. U.S.P. 2,409,234, 15.10.46. Regeneration of earth used in the decolorization of oils.

H. V. Atwell, assr to The Texas Co. U.S.P. 2,409,235, 15.10.46. A continuous cyclic process for the catalytic formation of liquid compounds from carbon and hydrogen by the action of a solid hydrogenating catalyst containing a carbide-forming metal.

J. W. Brooks, A. A. Kelly, and R. H. Work, assrs to Socony-Vacuum Oil Co. U.S.P. 2,409,247–8, 15.10.46. Mono fluo- and difluo-phosphoric acids are employed as catalysts in the polymerization of olefins.

T. F. Doumani and R. F. Deering, assrs to Union Oil Co. U.S.P. 2,409,259, 15.10.46. A thermal process for producing conjugated dienes boiling below 43° C.

E. L. d'Ouville and B. L. Evering, assrs to S.O.C. Indiana. U.S.P. 2,409,260, 15.10.46. A butane isomerization process.

R. F. McCleary, assr to The Texas Co. U.S.P. 2,409,296, 15.10.46. A lub. oil additive consisting of an oil-soluble sulphurized derivative of a partially hydrogenated cardanol.

J. R. Morris and R. F. McCleary, assrs to The Texas Co. U.S.P. 2,409,303, 15.10.46. A lub. oil additive.

P. H. Williams, assr to Shell Dev. Co. U.S.P. 2,409,329, 15.10.46. Organic thiocyanic compounds.

D. L. Wright and C. W. Bohmer, Jr., assrs to S.O. Dev. Co. U.S.P. 2,409,332, 15.10.46. A white-oil composition containing a linear polymer of an oxygen containing aliphatic compound.

D. W. Young, assr to Jasco Inc. U.S.P. 2,409,336, 15.10.46. Polybutene is the chief component of a chemical-resistant coating material.

M. P. Matuszak, assr to Phillips Petroleum Co. U.S.P. 2,409,372, 15.10.46. Organic fluorine is removed from hydrocarbon mixtures by treatment with an active metal oxide catalyst in the presence of ammonia.

E. B. Peck, assr to Standard Catalytic Co. U.S.P. 2,409,382, 15.10.46. Cracked gasoline is subjected to superfractionation, hydrogenation, and aromatization to produce high octane fuel.

C. R. Ringham, assrs to Phillips Petroleum Co. U.S.P. 2,409,389, 15.10.46. Di-*iso*propyl is obtained by the alkylation of *iso*butane with ethylene in the presence of $AlCl_3$ catalyst.

W. E. Ross and P. Pezzaglia, assrs to Shell Dev. Co. U.S.P. 2,409,390, 15.10.46. A process for simultaneously isomerizing and separating *cyclo*paraffins from acyclic paraffins by means of an aluminium hydrocarbon complex.

J. D. Morgan and R. E. Lowe, assrs to Cities Service Oil Co. U.S.P. 2,409,443, 15.10.46. A lubricant for instrument bearings is composed of equal weights of tricresyl phosphate and ethylene glycol monobenzyl ether.

J. D. Morgan and R. E. Lowe, assrs to Cities Service Oil Co. U.S.P. 2,409,444, 15.10.46. A clock lubricant comprises a mixture of tricresyl phosphate, dibutyl phthalate, and triethylene glycol di-2-ethyl butyrate.

G. D. Creelman and J. F. Crowther, assrs to M. W. Kellogg Co. U.S.P. 2,409,476, 15.10.46. A method of conducting catalytic vapour-phase conversions.

G. H. Keating, assr to The Texas Co. U.S.P. 2,409,494, 15.10.46. Manufacture of catalysts in ring form.

L. A. Clarke, assr to The Texas Co. U.S.P. 2,409,544, 15.10.46. Catalytic alkylation of *iso*butane with ethylene to give 2 : 3-dimethylbutane.

A. S. Ramage, assr to A. A. F. Maxwell. U.S.P. 2,409,587, 15.10.46. A combination hydrocarbon dehydrogenation and hydrogenation process to give an aromatic product.

R. H. Hill and C. H. Watkins, assrs to S.O. Dev. Co. U.S.P. 2,409,681, 22.10.46 Preparation of an $AlCl_3$ catalyst for an alkylation process.

J. G. McNab and D. T. Rogers, assrs to S.O. Dev. Co. U.S.P. 2,409,686–7, 22.10.46. Complex lub. oil additives containing sulphur.

E. W. S. Nicholson and A. K. Redcay, assrs to S.O. Dev. Co. U.S.P. 2,409,690, 22.10.46. Desulphurization of hydrocarbon oils using hydrogen and a catalyst.

F. G. Noble, assr to S.O. Dev. Co. U.S.P. 2,409,691, 22.10.46. A two-stage absorption process for extracting gasoline from high-pressure gas.

K. C. Laughlin, assr to S.O. Dev. Co. U.S.P. 2,409,695, 22.10.46. Aromatization of gasoline in two stages using hydrogen and (*a*) molybdenum oxide–alumina and (*b*) chromium oxide–alumina, as catalysts.

F. E. Reinhardt, assr to Richfield Oil Corpn. U.S.P. 2,409,705, 22.10.46. Design of a filter leaf for discontinuous, stationary, leaf-type filters.

C. Winning and J. G. McNab, assrs to S.O. Dev. Co. U.S.P. 2,409,726, 22.10.46. A petroleum lubricant for machinery which contains minor amounts of a metal salt of a polybasic inorganic acid and a higher alcohol.

G. C. Bailey, assr to Phillips Petroleum Co. U.S.P. 2,409,727, 22.10.46. Polymerization of di-*iso*butylene to tetra-*iso*butylene using phosphorus pentoxide as catalyst.

T. W. Evans and A. G. Cattaneo, assr to Shell Dev. Co. U.S.P. 2,409,746, 22.10.46. Methyl *tert.*-butyl ether is added to a selected hydrocarbon mixture for use in supercharged engines.

C. G. Gerhold and J. E. Burgess, assrs to U.O.P. Co. U.S.P. 2,409,751, 22.10.46. Method of regenerating a cracking catalyst.

D. B. Luten, Jr., and A. De Benedictis, assrs to Shell Dev. Co. U.S.P. 2,409,773, 22.10.46. Two-stage distillation for the separation of ortho-substituted conjugated ring compounds.

L. A. Mekler, assr to U.O.P. Co. U.S.P. 2,409,780, 22.10.46. Design of a reactor.

V. Mertz, assr to Phillips Petroleum Co. U.S.P. 2,409,781, 22.10.46. In extractive distillation with furfural an alkali metal bicarbonate is added to the solvent to prevent corrosion of the equipment.

E. N. Roberts, assr to S.O.C. Indiana. U.S.P. 2,409,799, 22.10.46. Lub. oil additives consisting of a polyaminopoly–aryl methane and a neutral phosphorus–sulphur–hydrocarbon complex.

L. Schmerling, assr to U.O.P. Co. U.S.P. 2,409,802, 22.10.46. Ethylbenzene is produced from benzene, ethyl alcohol, and ethylene in the presence of phosphoric acid catalyst.

C. K. Viland and H. Y. Hyde, assrs to Tide Water Associated Oil Co. U.S.P. 2,409,815, 22.10.46. Amylenes are produced by the high temperature thermal cracking of *n*-hexane in the presence of C_2–C_3 hydrocarbons.

R. L. May, assr to Sinclair Refining Co. U.S.P. 2,409,877–8, 22.10.46. Lub. oil inhibitors are made from the reaction product of an alkylated phenol with the condensation product of turpentine and phosphorus pentasulphide. G. R. N.

PRODUCTS.

Chemistry and Physics.

877. Boron-Trifluoride Catalysed Reaction of Di-*iso*butene. A. G. Evans and M. A. Weinberger. *Nature*, 1947, **159**, 437.—At low pressures and room temperature di-*iso*butene vapour, purified by distillation over sodium, does not react on mixing with

boron trifluoride, but a small amount of added water or acetone combines with the trifluoride in equal molar quantities and polymerization of the hydrocarbon occurs. Ammonia reacts but produces no polymerization, which, however, is induced by subsequent addition of water vapour. Oxygen, hydrogen sulphide, and hydrogen chloride do not combine with the boron trifluoride, but the addition of water vapour in all cases produces rapid reaction. H. C. E.

878. Structures of Ethylene Oxide and *cyclo*Propane. R. Robinson. *Nature*, 1947, **159**, 400.—Walsh's communication (*Nature*, 1947, **159**, 165; Abstr. No. 617) is criticized because: (1) It is incorrect that trimethylene oxide is less stable than ethylene oxide; (2) The reactions of ethylene oxide are not similar to those of ethylene, but to those of acetaldehyde; (3) The broad conception of electron donation by bonding electrons is not novel; (4) The formulæ $O \leftarrow \begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix}$ and $H_2C \leftarrow \begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix}$ for ethylene oxide and *cyclo*propane are unsatisfactory in that the dipole moment of the former structure is much greater than the experimental value; and an analogous formula for azoxy compounds has been proved incorrect. H. C. E.

879. Development and Maintenance of Pure Hydrocarbon Standards. R. G. Alden and J. W. Tooke. *Oil Gas J.*, 1.2.47, **45** (39), 42.—An account is given of the development and maintenance of pure hydrocarbon standards. The methods and operations involved in the manufacture of such standards by the two main routes: (1) from naturally occurring mixtures and (2) by synthesis, are outlined, and brief reference is made to the degrees of purity attained by the A.P.I. and the Bureau of Standards. The effects of impurities on hydrocarbon standards are discussed and shown in a table. A typical pure hydrocarbon storage installation is illustrated and its design and layout for the avoidance of contamination throughout manufacture and the maintenance of purity of the final products are discussed. Emphasis is placed on the following: care and periodic inspection of the equipment to avoid contamination by leaks through valves, lubricants in pumps and valves, etc.; necessity of sufficient tanks, each with individual lines, etc., to ensure time for testing each before transfer to final storage; final tanks should be sealed with blind flanges and have separate gravity flow-lines for filling containers, and their contents should be protected from air oxidation by the use of an inert gas. The use of inhibitors for protecting the standards from oxidation or polymerization is discussed. Shipping containers and loading procedures are surveyed from the aspects of cleanliness and inspection, etc. Testing methods and equipment for the control and analysis are discussed, *e.g.*, calorimeters, freezing-point and melting-point apparatus and precise controlled water-baths, the Mass and Infra-red spectrometers, etc. Ten literature references are given. W. H. C.

880. Thermodynamic Properties of Hydrocarbons. II. Numerical Data and Examples. N. Tcherkezoff. *Rev. Inst. Franç. Pétrole*, 1947, **2**, 49–53 (see Abstract No. 735 (1947)).—This concluding instalment gives 7 graphs (2 previously published) illustrating data presented in the previous articles. The graphs compiled by the author show: variation of hydrocarbon entropies at 25° C with the number of C atoms; free energies of hydrocarbons at 25° C as a function of the number of C atoms; free energy of olefins (per C atom) as a function of the temperature; free energies of the C_6 hydrocarbons as a function of the temperature; the true specific heat of gaseous hydrocarbons as a function of their density and of the temperature and the mol specific heat of the vapours of a number of hydrocarbons (at atmospheric pressure) as a function of the temperature. V. B.

881. Recent Developments in Industrial Emission and Absorption Spectroscopy. *J. sci. Instrum.*, 1946, **23**, 292–301. (*Summarized Proceedings of Conference on Industrial Spectroscopy*, London, July 5 to 6, 1946, *organized by the Industrial Spectroscopic Group of the Institute of Physics.*)—In the first paper, "The Significance of Infra-red Spectroscopy in Analysis" (H. W. Thompson), the theoretical and applicational aspects of infra-red absorption spectra were discussed. Examples of typical industrial analytical methods were described, mention being made of new instruments with which continuous analysis can be applied to flow lines or to reaction mixtures.

G. F. Lothian described equipment for infra-red absorption spectrophotometry, and recent improvements in speed and convenience in obtaining spectra. Other speakers described analytical problems involving gaseous mixtures, organic liquids, polymers, etc., recent German developments, and the limitations and advantages of analytical methods based on the Raman effect.

The second half of the proceedings, dealing with emission spectrography, included papers on "Modern Equipment for Emission Spectrographic Analysis" (A. S. Nickelson and F. W. J. Garton) and "Spectroscopic Light Sources for the Analysis of Metals and Alloys" (A. Walsh); other speakers discussed the inadequate specification of sparking conditions, unpublished work abroad, arc and spark discharge phenomena, and the film and plate controversy. The concluding paper dealt with "A Statistical Examination of Sources of Error in the Spectrographic Analysis of Low Alloy Steel" (H. T. Shirley). C. N. T.

882. Evolution of Energy in Jet and Rocket Propulsion. P. Bielkowicz. *Aircr. Engng*, 1947, **19**, 19.—The concluding article in this series deals with the dissociation of diatomic gases, explosive reaction, flame speed, and the combustion of CO. I. G. B.

883. Oil Pipelines. A. Lugaresi. *Riv. ital. Petrol*, Jan., 1947, **165**, 12.—A review is given of the theory of flow of fluids in tubes, from which are deduced expressions for the pressure drop along pipes of given dimensions. D. H. McL.

Analysis and Testing.

884. Engine Testing of Fuels and Lubricants. 3 (2). Fuel Consumption and Power Output. P. H. Moore. *Petroleum*, 1947, **10**, 38.—The control of operating conditions is very important as any difference in fuel properties is likely to be small. Means of effecting such control are discussed. Subsequently details are given of the methods of test for both spark ignition and diesel fuel. K. C. G. K.

885. Molecular Weights in Practice and Theory. II. Theory. 2. Derivation of $\theta = Km$. A. V. Brancker. *Petroleum*, 1947, **10**, 32.—This instalment deals with the derivation of the approximation $\theta = Km$ (where θ represents temperature change, K is a constant and m molality) from fundamental thermodynamic equations. A modified equation, $\theta = Km^b$ is introduced, where b is a constant nearly equal to unity. K. C. G. K.

886. Physical Research Methods Increase Knowledge of Catalysts, Hydrocarbons. G. M. Webb. *Oil Gas J.*, 22.3.47, **45** (46), 203.—A general review of the use of the electron microscope, X-ray, and electron diffraction; infra-red, ultra-violet and Raman spectroscopy and mass spectrometry as applied to hydrocarbons, catalysts, and other substances is given.

For example, X-ray diffraction methods were applied to the problem of obtaining uniform distribution of molybdena throughout the alumina, which composite is extensively used in the hydroforming process for production of toluene from petroleum. The diffraction methods quickly established that a catalyst of greatly improved heat stability could be prepared by adding molybdenum compound to the wet undried alumina hydrogel.

Radiation cycles used for the various investigations varied from low values of one cycle in hundreds of years to 10,000 million cubed cycles per sec. G. A. C.

887. Second Report on Tests for Soil Stabilization. Soil Stabilization Panel of the Institute of Petroleum Standardization Committee. *J. Inst. Petrol.*, 1947, **33** 113.—The work of the Panel on the following is described: (1) determination of frost resistance of compacted mixes; (2) determination of stabilizer content of mixes; (3) sampling and treatment of samples in field testing; (4) standardization of methods of compaction, applicable to all tests. The appendices to the paper describe the various tests. A. H. N.

888. Greater Trend Toward Petroleum Performance Specifications in 1947. C. M. Larsen. *Oil Gas J.*, 22.3.47, **45** (46), 181.—The stating of chemical and physical properties of petroleum products as measured by laboratory tests is giving way to performance specifications, which latter require a guarantee of future performance in service or "life tests" under actual or similar conditions. For example, the only suitable tests to determine whether or not a gear lubricant is satisfactory for a hypoid axle at high speeds is to put the lubricants in the axle and run the car at the high speeds. Other products discussed are premium oils, motor and aviation gasoline, and fuels for diesels, gas turbines, rockets, and jets; and lubricants for same. G. A. C.

889. Spectroscopic Analysis: Application of the Hydrogen Discharge Lamp to the Analysis of Mixtures of C_8 Aromatic Hydrocarbons. R. R. Gordon, H. Powell, and J. Tadayyon. *J. Inst. Petrol.*, 1947, **33**, 103.—Two methods of using the hydrogen discharge lamp employed by other workers are described and examples of the application given. It is shown that neither of these methods gives accurate analyses. A third method has been developed which, by the use of a microphotometer, makes possible a quantitative measure of the absorption at any wavelength. This method in its present stage of development is not so accurate as the Spekker method normally used, but reasons are given for the opinion that it may be made at least as accurate as the normal method. The method using the microphotometer is not so rapid as the Spekker method for the analysis of isolated samples, but is more rapid when analyses are required on a series of samples whose composition and concentration are known approximately. The accuracy obtained is shown by the analysis of nineteen synthetic mixtures to be approximately $\pm 5\%$, *i.e.*, 10% $\pm 5\%$, or 90% $\pm$ 5%. A. H. N.

890. Viscometry of Soap-in-Hydrocarbon Systems. G. F. Wood, A. H. Nissan, and F. H. Garner. *J. Inst. Petrol.*, 1947, **33**, 71.—A capillary viscometer of laboratory-scale and its counterpart using steel pipes up to 2 in in diameter for the "capillary" are described. Aluminium soaps dissolved in petrol showed a different inlet loss from Newtonian liquids. In pipes a new phenomenon described as "negative slip" is revealed. The end-effects of rotary viscometers when used on soap-in-hydrocarbon systems may be different from those normally observed, due to secondary flow. In falling sphere viscometry, the evaluation of a mean rate of shear is shown to include functions of both the radius of the sphere and of the full tube. Discrepancies appear to exist between the viscosity measured in a capillary apparatus and that using falling spheres. A. H. N.

Gas.

891. Gas Dehydration at Pecan Island. E. H. Short. *Oil Gas J.*, 12.4.47, **45** (49), 82.—The gas dehydration plant at Abbeville, La, erected by Humble Oil and Refining Co., is described.

5 wells in the gasfield are producing and 3 more are to be drilled. The maximum capacity of the plant is 50 million cu. ft. per day; at present 15 to 40 million cu. ft. of gas per day are processed. Tests show that 1250 lb of water was removed from 45 million cu. ft. of gas. The gas is passed to flow-line heaters equipped with 2-in 5000-lb w.p. tubes. Water removal is accomplished by contacting the gas with diethylene glycol, after passing through a scrubber in the bottom of the contactor. This removes free water and condensate; the gas then passing upward through standard bubble-cap plates where it contacts the diethylene glycol. The third stage consists of removing traces of the glycol in a second scrubber located in the top of the contactor shell. The accumulating glycol solution is dealt with in a heat exchanger, passed to a still where the water is driven off and the glycol recovered for use.

The contactor can operate at a maximum pressure of 1000 p.s.i., and dehydrated gas is delivered from the plant at pressures up to 1000 lb to a consumer 65 ml distant. G. A. C.

Engine Fuels.

892. Vaporization of Fuels for Gas Turbines. Part II. Heat Quantities Required to Vaporize Gas Turbine Fuels. B. P. Mullins. *J. Inst. Petrol.*, 1947, **33**, 44.—The true specific heats in the liquid and vapour states and the latent heats of vaporization of

100-octane fuel and kerosine have been evaluated at various temperatures from empirical relationships and experimental data taken from the scientific literature. The heat contents (above 15° C) of the heated liquid fuels were evaluated, and a method was devised to enable the heat contents of the two standard fuels to be calculated under different total pressure and mixture ratio dew-point conditions. The method was carried out using the dew-point values calculated in Part I of this report, and the results are presented in the form of curves and two nomograms. These results have been converted into forms which may be applied directly to gas-turbine practice. The air temperature necessary to vaporize each of the standard fuels at a given total pressure and given final mixture ratio have been calculated. Further, the fuel temperatures necessary to produce vaporization under similar conditions have been calculated, and the results are presented in the form of 6 nomograms with auxiliary duplex scales. Finally, VOFAM (Vaporization of Fuel–Air Mixtures) were devised, one for each fuel, from which bubble-points, dew-points, heat contents, and air and fuel temperatures for vaporization at given pressures and mixtures ratios may be read off with the aid of a straight-edge. A. H. N.

893. Motor Fuels Used in Sweden. G. Egloff. *Petrol. Times*, 18.1.47, **51**, 64.—The various fuels used in Sweden during the war are reviewed. The most important motor fuels in common usage were: (1) producer gas, (2) alcoholic blends, (3) motor fuel from shale oil, and (4) acetylene. The use of these fuels is briefly discussed. R. B. S.

Gas Oil and Fuel Oils.

894. Burning Index for Distillates. A.P.I. Gravity and Mid-point of Boiling Range Quality Fuels. J. C. Reid and A. B. Hersberger. *Fuel Oil & Oil Heat.* (*Annual Oilheating Analysis and Show Number.*) Jan. 1947, 90–92.—Investigations carried out by the Atlantic Refining Co. to determine whether some readily available properties of an oil could be used to develop a correlation with actual burner performance have resulted in the production of a Burning Index Chart which is presented and described. It is based on the gravity and 50% b.p. of the oil and has been primarily developed for use with oils having approximately the distillation range of No. 2 fuel oil. The oils are burned in a burner-boiler combination set up so that both the air and oil-firing rate may be varied widely. Smoke densities of the flue gases are determined. The data from a series of tests are then plotted as air setting *v.* smoke density for the different firing rates. The curves obtained are then used as the basis for the construction of another graph, which, after the plot points have been completely lined up, encloses a zone, and shows the limiting conditions of burner operation defined by a smoke density of 20, or where that amount of smoke is not formed, by the design of the burner. The area of this zone, which has been termed the combustion envelope, plotted on a fixed scale, is then measured by a planimeter. The oil that shows the largest area is the best for the burner in question. The conversion of this area to constant burning index lines, as plotted in the Burning Index Chart presented is described. The accuracy with which a chart of this nature can be used to predict the burning qualities of an oil, either in terms of combustion envelope area or of burning index, is demonstrated by the tables given, wherein the actually determined values are compared to values read from the charts. A burning index to have maximum usefulness must be such that the index of blends can be predicted accurately from the indices and the proportions of the constituents present in the blend. The index presented handles this phase of the problem correctly as the data given shows. W. H. C.

895. Heavy Oils in Stationary Diesel Engines. M. Zwicky and H. Ringgenberg. *Gas Oil Pwr*, 1947, **42**, 69–72.—The present trend of oil-refining is such that fuels of high O.N. are produced by cracking and polymerization of heavier fractions, and diesel engines must therefore be operated on oil-refinery residues of poor ignition qualities instead of gas oil; but any increase in maintenance costs is offset by the cheapness of the heavier fuel.

Such fuels usually possess low-firing qualities and high Conradson coking number. Low-firing quality, particularly in small cylinders, results in incomplete combustion, leading to lacquer and ringsticking. Oils with high coke numbers lead to formation of deposits and increased wear, both erosive and corrosive. In designing an engine to

operate on low-grade fuels the criteria are: (1) large cylinders and moderate speeds, hot cooling of cylinders and covers, and adaptation of injectors and combustion spaces; (2) special cast-iron liners and preheating of fuel; (3) magnetic and other filters in the lubricant circuit. Pressure-charging gives only half the wear which is experienced in a normal engine.

A Sulzer engine designed on these lines is described. H. C. E.

896. Firing Oil. (Refiner's Notebook, No. 131.) W. L. Nelson. *Oil Gas J.*, 15.2.47, **45** (41), 109.—The two steam atomizing type burners used in refineries are (1) outside mix, where oil and steam issue separately from burner, (2) inside mix, more economical of steam, where oil and steam are mixed inside burner, and issue together.

Residual fuels are best, but gas oils, distillate fuels, naphthas, asphaltic residues, and acid sludge mixtures can be used, though acid sludge may corrode the burner. Optimum temperature for viscous fuels is such that Saybolt Universal viscosity is 130–250. Too high temperature may lead to spluttery flame or excessive coking within burner tip.

The best type of pump for steady pressure is rotary. Fuel pressure is often 40–60 p.s.i.g., rising to 125 p.s.i.g. for light gas oil. Amount of atomizing steam ranges from 1·6–4 lb per gal of oil for inside mix, to 10 lb per gal for outside mix.

Burner troubles discussed include spluttery flame, smoky flame, failure of ignition, and excess air. W. M. H.

Lubricants.

897. Apparatus for the Study of the Rheological Properties of Dielectrics. W. Lethersich. *J. sci. Instrum.*, 1947, **24** (3), 66–71.—The rheological properties of materials are usually studied by means of compressive, tensile, and shear tests. Compressive tests are generally made on cylindrical specimens, but these are subject to errors due to friction at the ends, unless the height of the cylinder is at least twice its diameter. An apparatus is described which will measure the compressive strain on specimens 3 cm in length and 1·3 cm diameter. Strains up to 0·12 can be measured to an accuracy of 10^{-4}, and the apparatus can be used without modification for tensile tests. The lateral strain can be determined at the same time, and to a similar order of accuracy.

The shear properties are measured on thin-walled cylinders of material and an apparatus has been constructed for applying the shear stress and measuring the shear strain. This apparatus is particularly suitable for studying relaxation phenomena, since there is no friction after the stress has been removed. Typical results are quoted for polyethylene, bitumen, polystyrene, etc. C. N. T.

898. Unusual Cause and Effect of Corrosion. A. H. Stuart. *Petroleum*, 1947, **10**, 26.—An unusual case of corrosion is described, caused by the iron content of natural graphite. The latter was admixed as lubricant with asbestos serving as packing material in a stuffing-box on the shaft of a large centrifugal pump (operating on river water) which developed a leak at the gland. A hydrochloric acid extract of the graphite revealed an iron content of over 6% (expressed as Fe_2O_3) which caused the accumulation of rust flakes in the stuffing material (both stuffing-box and shaft were of bronze). Results of the examination of other samples of graphite and of graphite substitutes are described. K. C. G. K.

899. Oleophobic Monolayers. I. Films Adsorbed from Solution in Non-Polar Liquids. W. C. Bigelow, D. L. Pickett, and W. A. Zisman. *J. Coll. Sci.*, 1946, **1**, 513–538.—Dilute solutions of eicosyl alcohol in *n*-hexadecane will not wet the grease-free surfaces of glass, platinum, and many other polished metals, which, however, are wetted by the pure solvent. The surfaces, after immersion in the solution, are found to be oleophobic and hydrophobic, and the phenomenon is therefore due to adsorption of the solute. As the solution is diluted, a longer time is required for the effect to develop, from which it was established that the adsorbed layer is monomolecular.

A platinum surface was dipped into a dilute solution of *n*-octadecylamine in dicyclohexyl, the contact angle (θ) between the horizontal surface and a drop of distilled water measured, and the surface cleaned by burning. When, by repeated dipping, θ was reduced below 75° it was assumed that all the solute was removed, and hence the average area per adsorbed molecule was calculated to be 30 Å. The molecular chain,

extending at right angles to the surface, terminates in a methyl head to which hydrocarbon molecules adhere only weakly. Increase in temperature or decrease in chain length will increase the solubility of the film. Monocarboxylic acids and primary amines of unbranched saturated paraffins in hexadecane form oleophobic films when the number of carbon atoms per molecule (N) >14. Compounds where $N<14$ are oleophobic to the solution but not to hexadecane; when $N<8$ no oleophobic films are formed. With analogous monohydric alcohols the corresponding values of N are 16 and 10. For a given concentration of solute the tendency to form oleophobic films depends upon the temperature.

The inability of unsaturated acids to form oleophobic films is explained by the V shape of the molecules, which do not, therefore, achieve the close packing of saturated molecules. Rinoleic and ricinelaidic acids, having two polar groups, are wetted by hexadecane, although barely oleophobic to the solution. Compounds containing branched chains do not usually form oleophobic films, and films oleophobic to the solution but not to the solvent are produced by sparingly soluble compounds.

The higher the viscosity of the solvent the longer time is required for complete adsorption. *n*-Octadecylamine forms oleophobic films in a wide range of non-volatile solvents. When the solubility of the substance is high oleophobic films do not form because the molecules are not packed tightly enough; and the solubility limit is reached before a close-packed monolayer is formed when the solubility is low. Certain substances, such as cholesterol, do not form oleophobic films from solvents from which the compound has a low lifetime of adsorption.

In measuring the wetting properties of pure hydrocarbons on monolayers adsorbed from hexadecane on platinum surfaces, θ was found to decrease with the boiling-point of the liquid. θ between a monolayer and each member of a homologous hydrocarbon series decreases with the boiling-point and molecular weight. The time required for the drop to wet the monolayer decreases with chain length.

θ of water on oleophobic monolayers is independent of the nature and location of the polar groups at the end of the oriented molecules, due to the fact that oriented methyl groups are presented to the water droplet. That values of θ for monolayers are smaller than those for solid paraffin waxes at the same temperature is because the latter surface is much rougher than that of a monolayer on a polished surface.

With solutions of oleophobic substances the film spreading on polished, grease-free surfaces is broken up until, finally, the surface is covered with droplets separated by apparently clear areas whose θ with hexadecane and water prove that they are covered with an adsorbed monolayer. The adhesion energy of the monolayer formed at the metal–oil interface is less than that for the metal surface, over which the oils will therefore spread preferentially. When the number of molecules is insufficient an oleophobic film is not formed and even spreading occurs.

The applications of these films and their properties to other problems and to industry include: (1) The surface-active properties of biological substances, such as cholesterol, can be studied by depositing monolayers on suitable surfaces. (2) Although adsorbed oleophobic films exhibit a low coefficient of friction the addition of such compounds to lubricating oils may hinder the wetting of the lubricated surfaces. Suggestions for maintaining oil flow in these circumstances are given; but the non-spreading properties of these oils would tend to keep the lubricant in the vicinity of the bearings. (3) The hydrophobic properties of monolayers can be used to protect metal surfaces from rusting or from corrosion. Data on inhibition of rusting by additives in turbine oils, hydraulic fluids, etc., can be explained on the basis of adsorbed monolayers.

H. C. E.

900. Lubricating Properties of Molecular Layers of Stearic Acid and Calcium Stearate on Metal Surfaces. J. N. Gregory and J. A. Spink. *Nature*, 1947, **159**, 403.—After depositing molecular layers of calcium stearate and stearic acid on copper, platinum, and stainless steel, the coefficient of friction, measured over a range of temperatures, was found to vary at temperatures corresponding to known physical changes in the lubricant. With copper these changes occurred at the melting-point of stearic acid and the softening-point of copper stearate. On stainless steel a change occurred at the softening-point of calcium stearate, and with platinum changes occurred at the phase transformation and melting-point of stearic acid. In general, the frictional effects, and the number of layers required for lubrication, depend on the nature of the metal.

That calcium stearate will lubricate steel but not copper or platinum may be because the latter require three and five layers respectively for lubrication, whereas steel requires only one. H. C. E.

901. Lubrication of Pre-Selective Gear-Boxes. A. T. Wilford. *J. Inst. Petrol.*, 1947, **33**, 1.—The paper deals with the lubrication problem which presented itself following upon the introduction of pre-selective gear-boxes on buses operated in the London Passenger Transport Board's area. Considerable difficulties were encountered attributable to severe oxidation of the oil, leading to drivers' complaints, service delays, and abnormal gear-box maintenance. The trouble, after much investigation, was kept within bounds by the use of a straight mineral oil of Pennsylvanian origin changed every 6000 ml; it was in course of time completely solved by the adoption of an inhibited turbine oil which remains in use throughout the 80,000 ml elapsing between consecutive gear-box overhauls. The results of service tests carried out both prior and subsequent to this satisfactory outcome and involving a variety of lubricants, eight of which contained oxidation inhibitors, are briefly reviewed. The necessity for conducting such tests on an adequate scale and for a sufficient length of time is emphasized, while the need for developing an oxidation test which might serve to reduce the duration of service tests is remarked upon. With the object of widening sources of supply, tests with a further number of inhibited oils have quite recently been commenced, and it is pointed out that those eventually approved as suitable for use as pre-selective gear-box lubricants must be compatible with one another. A. H. N.

902. Steam Turbine Lubrication Problems and Their Solutions. LII (3). Cooling Function of the Oil. A. Wolf. *Petroleum*, 1947, **10**, 30.—If the demulsibility of the oil becomes considerably reduced without being noticed, water leakage into the oil may raise the water content sufficiently to produce thick, custard-like emulsion sludges which may obstruct strainers and fine oil ways. Another danger is that the rate of water leakage may increase suddenly so that the water level in the oil reservoir rises to the pump suction and a mixture of oil and water with inadequate lubricating power is pumped to the bearings.

Serious trouble will arise if the water becomes corrosive through pollution, for the cooler tubes will be attacked. Pin-holes may form because of preferential solution of zinc grains if the tubes are of brass. This may also occur with acid oil. Even copper or bronze tubes will be attacked by sea-water. In such cases an iron rod fixed from end to end of the cooler has proved effective; the rod is very often corroded away by galvanic action. Dirty cooler water greatly reduces oil cooler efficiency due to deposition of slime and dirt. If the cooler capacity is too small, its efficiency may be improved by rendering the oil flow through tubes turbulent in character. Leakage of water from the auxiliary oil-pump, usually directly driven by a small vertical steam turbine mounted on top of the oil-tank must also be guarded against.

The oil-tank or reservoir is the most important unit in the lubrication system after the oil-pump and cooler. Oxidation of the oil is greatly accelerated by the presence of air bubbles, water droplets, and ferruginous solids in suspension and no effort should be spared to remove such impurities as soon as possible.

As regards demulsification, it is stated that inhibited turbine oils may attain emulsion numbers of at least 200 to 300 in service and uninhibited oils number of at least 600 without any apparent bad effect on the working of the turbine. In fact, many units have been successfully operated with uninhibited oils having S.E. numbers of 1200+. Relaxation of the present severe requirements for initial demulsibility has recently become more necessary because of the introduction of "rust inhibited" turbine oils, which contain both an oxidation inhibitor and a rust inhibitor, as the latter destroys some of the demulsibility of the mineral oil base. K. C. G. K.

Bitumen, Asphalt, and Tar.

903. Rubber–Asphalt Joint Fillers. R. H. Lewis. *Public Roads*, Jan.–Mar. 1947, **24** (11), 291.—A review of material extensively used for filling joints in concrete runways, specifications and testing procedure is given.

Rubber–asphalt blends have been satisfactorily used for some time as joint fillers and found superior to the more common types of hot-poured materials. Failure of

some rubber–asphalt compounds has been traced to overheating the materials and to maintaining them at high temperature for long periods. Thus chemical changes are caused which alter the physical properties of the material, such as penetration and ductility, and impairs those characteristics desirable in efficient joint fillers. Laboratory experiments show that rubber–asphalt compounds should be heated to controlled optimum temperatures, and batches should not be heated for extended periods. Rapid methods of pouring should be used.

Experiments also show that the softening-point test should replace the prolonged flow test called for in the present specification; also the standard needle test should replace the cone penetrometer method. G. A. C.

Special Hydrocarbon Products.

904. Sulpho-Chlorinated Cutting Oils. D. G. Bagg. *Petrol. Times*, 12.4.47, **51**, 338.—A brief review is given of the development of cutting oils. The latest development is in the use of sulpho-chlorinated or straight oils in place of soluble oils. These straight oils enhance the accuracy of machining and provide better lubrication resulting in economy of power. The improvement in machining accuracy is due to: (1) the superior cooling ability of straight oils which keeps down the temperature and reduces microscopic surface faults due to heat distortion, and (2) the prevention of welding of microscopic chips to the tool by the presence of sulphur and chlorine, thereby increasing the life of the tool and improving the accuracy of machining.

These sulpho-chlorinated cutting oils are produced in concentrated form by the sulphurization and chlorination of mineral oil. They are then blended with a suitable viscosity oil in concentrations of 5–15% depending on the nature of the work. These oils can be recovered by centrifuging, filtering, or settling, without deterioration of characteristics. Their one disdavantage is that they are liable to stain alloy-metals which are more readily attacked by sulphur. R. B. S.

Derived Chemical Products.

905. Applications of Petroleum Chemicals. Anon. *Petrol. Times*, 15.3.47, **51**, 206.—The numerous applications of petroleum chemicals in various fields of industry are discussed under the following headings: (1) agriculture and horticulture; (2) building; (3) chemicals; (4) cleaning; (5) engineering; (6) hospitals; (7) leather and fur; (8) paints; (9) plastics; (10) rubber; (11) shipping; (12) textiles and laundering; and (13) miscellaneous.

The chemicals listed are being made available in Britain by extensive developments in the chemical manufacturing plants of the Shell Petroleum Company. R. B. S.

Coal, Shale, and Peat.

906. Retorting Oil Shale by the Fluidized Solids Technique. F. H. Blanding and B. E. Roetheli. *Oil Gas J.*, 15.2.47, **45** (41), 84.—Standard Oil Development Co. undertook in 1942 an investigation into the use of Australian Shale for the production of marine fuel oil by the new fluidized solids technique.

A very rich shale was used, containing 63% carbon and 8% hydrogen by weight, and was crushed to a particle size of ¼ in. Oil was removed by heating to a temperature of 850–1000° F, the fixed-bed type of operation preventing agglomeration which would otherwise have occurred at this temperature.

A small-scale batch-retorting was first carried out followed by pilot plant operation. A flow sheet and description of the pilot plant are given, together with yields and operating conditions. The shale was distilled in a 4-in vertical retort, 10 ft high, containing a fluidized bed of shale ash, maintained in a fluidized condition by air injected into the bottom of the retort. Gases and oil vapours passed into the filter section, to remove shale fines, and, finally, into a condenser and separating drum. The intimate mixing of the solid bed allowed very rapid heating of both shale and air, and insured against hot spots at the air inlet, and consequent formation of large clinkers. Operating temps. ranged from 850° to 1000° F, charge rates from 500 to 1,250 lb shale/hr/sq. ft of reactor cross-sectional area. Removal of hydrocarbons from shale was found to be a function of temp. Heat for distillation was provided by burning, in the reactor, carbon and hydrogen left on the spent shale, and some distilled oil vapours.

Analysis of crude oil and hydrocarbon gases produced are shown. Yields of crude oil were between 2·5 and 3·0 brl per ton of shale retorted, decreasing with increase in operating temps. The oil was relatively high-boiling, 15–25% in the gasoline range, with a gravity of 20–25° A.P.I. and could be made suitable for marine fuel by topping. The spent shale should have a good heating value.

From pilot plant data a process design was prepared, and is described, using a minimum quantity of steel and discarding gas and gasoline fractions as war-time emergency measures.

Costs cannot yet be reliably predicted, but may be competitive with other crude-oil production methods. American shales can be treated by the process as successfully as those from Australia. W. M. H.

Miscellaneous Products.

907. Chemicals from Petroleum. J. E. Bludworth. *Oil Gas J.*, 12.4.47, **45** (49), 76.—A review is given of the various syntheses of petroleum chemicals from the oxidation of hydrocarbons.

The chemical steps in the processes are given in detail and include production of aldehydes for use in plastics; alcohols as solvents; dye, pharmaceutical and other chemical intermediates; ketones for solvents, and acids for all types of syntheses. All the materials used are produced from hydrocarbon gases; many more could be made, but development depends on industrial demand. G. A. C.

908. Colour Lakes. Anon. *Paint Technology*, 1946, **11**, 437.—Two U.S. patents, assigned to the Sun Oil Co., California, by C. Alleman and J. R. Perrine, cover the manufacture of colour lakes from a group of acids of the C_nH_{2n}-8·O_2 and C_nH_{2n}-10·O_2, and having refractive indices of between 1·49815 and 1·51326, from the residues obtained in the distillation of lubricating oil stocks. The lakes are made by precipitating the water-insoluble salts (Ca, Ba, Zn, Al) from the sodium salts of the crude acids in the presence of suitable water-soluble dyes, and are suitable for use in the production of printing inks, and paints, etc. Specification No. 2,277,194 describes the preparation of dry granular lakes, after first separating the oily matter of the crude acids by treatment of the sodium salts under super-atmospheric pressure, when two layers are formed and separate. In Specification No. 2,056,931, the conditions are given for the production of the colour lakes in the presence of the oily matter. The lakes by this method are tacky, non-drying, and paste-like or semi-solid at normal temperatures, but if incorporated with suitable vehicles they may be employed in the production of printing inks and coating compositions. W. H. C.

909. Waxes and Similar Substances in the Rubber and Allied Industries: Lubricants, Softeners, Extenders, and Insulating Materials. W. S. Penn. *Petroleum*, 1947, **10**, 36.—The term "waxes" is used here not only to cover all kinds of animal, vegetable, and mineral waxes and wax-like hydrocarbons, but various other substances such as fatty acids, metal soaps, asphalts, bitumens, petroleum residues, and a wide range of natural and synthetic thermoplastic materials. Uses of such products in the rubber and allied industries are covered, *e.g.*, the manufacture of tyres, cables, hose, belting, etc., and in those industries mainly characterized by their use of high polymers (plastics, paint and varnish, lacquer, plywood, electrical insulating materials, etc.). The use and nature of internal lubricants both for rubber-like products (elastomers) and plastics is discussed. Typical compositions are given. External lubricants are often necessary to improve the surface appearance of moulded products (elastomeric and plastic). Various waxes are used to cover the surfaces of the moulds for this purpose. Anti-stick compounds are very closely related to such external lubricants. Softeners are used for the internal lubrication of many very hard compounds used in moulding. Plasticization must be distinguished from softening; it must be employed if the intermolecular forces of any polymer are very strong in order to improve the processing properties and to make the plastic more flexible.

Thermoplastics are comparable with waxes having long chains of carbon atoms with 30 to 60 carbon atoms. However, thermoplastic chains may have from 100 to several thousand carbon atoms depending on the type of polymer and the degree of polymerization. Generally, the chains are not joined together, but can flow over each other, *i.e.*, become soft or even sticky in the case of the lower polymers. Synthetic

and natural rubbers contain similar chains which are, however, unsaturated, each unit having a double bond (isoprene, butadiene, etc.). Cross-linkage of the chains is here usually brought about with sulphur. Accelerators are used to speed up this curing process with elastomers. Such accelerators are not satisfactory by themselves, requiring the addition of activators. Stearic acid is commonly used for this, but many fatty acid salts may also be employed. Extenders are often used in rubber compounds to reduce cost, *e.g.*, liquid and solid petroleum residues.

One of the most important uses of wax in the plastics and rubber industries is for electrical insulation, particularly in the case of cables, coils, and condensers (paraffin wax, ozokerite, and montan wax). Many thermoplastics used for similar purposes are very important and will be discussed separately. K. C. G. K.

910. Secrets of German Fuel Technology Unearthed. Anon. *Petrol. Times*, 29.3.47, 51, 282.—The following BIOS final reports are briefly reviewed :

BIOS Final Report No. 642 : German Oil Storage Blending and Filling Installations on WIFO Oil Storage Depots located at Eickeloh, Rüthen, and Nienburg : with particular reference to drum and can filling. (*Note.*—The number of this report is printed as 42, but it seems obvious that it should be 642.)

BIOS Final Report No. 662 : Manufacture of Phenylbetanaphthylamine at I.G. Farbenindustrie, Ludwigshafen. H.M.S.O., 6*d*.

BIOS Final Report No. 666 : I.G. Farbenindustrie Uerdingen : Manufacture of Phthalic Anhydride, Benzoic Acid, etc. H.M.S.O., 1*s*.

BIOS Final Report No. 732 : Lüneburger Wachswerke A.G. Lüneburg-Germany, Waxes.

BIOS Final Report No. 805 : Aspects of the Synthetic Fatty Acid and Synthetic Fat Industries in Germany. 99 pages. R. B. S.

Engines and Automotive Equipment.

911. Rolls-Royce Eagle. Anon. *Flight*, 1947, 51, 368.—The new Eagle is a twin-crank flat-H sleeve-valve engine aspirated with a two-stage two-speed supercharger and, in Mk 22 form is equipped to drive an eight blade contra-rotating airscrew. Leading particulars are :—

Bore and Stroke	5·4 in × 5·125 in
Total Swept Volume	46 litres
Cylinder Compression Ratio	6·5 : 1
Max. Internal Comp. Ratio of Supercharger	4·18 : 1
Max. b.h.p.	3500 at 2750 ft
Max. b.m.e.p.	282 p.s.i.
Power-Weight Ratio	0·9 b.h.p./lb

I. G. B.

912. Theseus Air Testing. Anon. *Flight*, 1947, 51, 273.—Following official test schedules, leading particulars and preliminary performance data are given :—

Reduction Gear Ratio	0·119 Airscrew Turbine Speed (L.H. Tractor)
Compression Ratio (Sea Level Static)	4·4 : 1
Compressor Speed	8200 r.p.m.
Air Delivered by Compressor (Sea Level Static)	30 lb/sec
Power Absorbed by Compressor (Sea Level Static)	3500 b.h.p.
Airscrew Turbine Speed	9000 r.p.m.
Airscrew Speed	1070 r.p.m.
Oil Max. Power	3 pt/hr

	Theseus Series TH. 11 (Without heat exchanger)	Theseus Series TH 21 (With heat exchanger)
	Max. continuous power output and fuel consumptions.	
Sea Level Static	2180 b.h.p. + 600 lb jet (0·80 lb/b.h.p./hr)	1950 b.h.p. + 500 lb jet (0·70 lb/b.h.p./hr)

I. G. B.

913. Some Problems of Cylinder Bore Wear. W. A. Robotham. *J. Instn. auto. Engrs*, 1947, **15**, 115–147.—Drawing on extensive records and experimental data, the effects of a wide range of design and operation variables on cylinder bore wear and oil consumption are discussed. Consideration of the performance of cars 15 and 20 years old under modern traffic conditions shows that in spite of the lack of most features which have been widely publicized as conducive to good cylinder life, they have a better durability than contemporary models. The average wear figure for some hundreds of these veterans is 0·00008 in per 1000 miles—or 100,000 miles between re-bores, which is far better than the results at present being achieved on their successors. Amongst the factors named as being responsible for the reduced cylinder life of the modern car are increased gas pressure and higher piston speeds. The author suggests that bore life can only be improved by way of the cylinder-bore material. A particularly promising treatment is thin chromium plating of the top region only of the bore.
P. T.

914. Recent Developments in Low-Temperature Starting of Petrol and Compression-Ignition Engines. R. Barrington, W. A. Bevis, and K. Brook. *J. Instn. auto. Engrs*, 1947, **15**, 51–82.—A description of work undertaken to ensure that internal combustion engines intended for land forces during the war should start at 0° F or lower. The method of approach is discussed in full giving consideration to lubricant, fuel, dilution of lubricant, carburation, ignition, priming system, manifold, and fuel pump of the petrol engine. For the diesel engine similar considerations are given and the development of apparatus for using ether as an ignition promoter with a simple form of carburettor is described. Finally, a satisfactory starting system for temperatures as low as − 30° F was produced which required in the case of the petrol engine modification of the carburation and ignition system and for the diesel engine the use of a simple form of carburettor and equipment for making use of an ether ignition promotor. The article finishes with a description of the development of batteries for low-temperature operation.
G. P. K.

915. Free-Piston Compressor-Engines. Anon. *Nature*, 1947, **159**, 413.—The free-piston compressor-engine is a reciprocating air compressor driven by a reciprocating two-stroke diesel engine, with the two opposing pistons coupled directly and without a fly-wheel. Energy for the compression stroke is supplied by the compressed air in the compressor cylinder. To improve the balance the engine cylinder has two pistons connected so that their displacements are equal and opposite, and starting is accomplished by bringing them together suddenly. The amount of injected fuel is varied automatically to keep the output air pressure constant, the effect of varying the air–fuel ratio being to change the stroke of the assembly.

The use of such an engine instead of a rotary air compressor in a gas turbine unit is under investigation. All the air pumped by the compressor cylinder is fed to the engine cylinder for scavenging and supercharging, and the hot exhaust gases then pass through a gas turbine. It is claimed that an overall efficiency of 41% is obtainable.
H. C. E.

916. Waukesha–Hesselman Low Compression Engines. Anon. *Gas Oil Pwr*, 1947, **42**, 87–88.—A new range of diesels ranging from 29 b.h.p. to 218 b.h.p. use low-grade fuel. The stroke–bore ratio is almost 1 : 1, and the combustion chamber is formed by a symmetrical dishing of the piston crown. Starting is effected by petrol, and in operation a tar oil or tractor distillate can be used. Aluminium alloy or cast iron pistons are fitted with tapered pressure rings.
H. C. E.

917. 2000-H.P. Gas Turbine Generator Set. Anon. *Gas Oil Pwr*, 1947, **42**, 77–79.—An experimental 2000-h.p. gas turbine generator, weighing 19 lb per h.p., burns bunker C fuel oil and gives an estimated thermal efficiency of 20% on full load. Incoming air is compressed up to 70 p.s.i. and mixed with fuel sufficient to produce a maximum burning temperature of 1350° F. The turbine develops 6000 h.p., of which 4000 h.p. are used to drive the compressor, and the remainder is delivered to a D.C. generator. Detailed descriptions of the compressor, combustion chambers, gas turbine, and generator are given.
H. C. E.

918. A 2000-H.P. Gas Turbine. T. J. Putz. *Motor Ship*, Apr. 1947, **28**, 38.—Extracts from the American Westinghouse open-cycle design are given. Sectional drawings are the longitudinal section through the compressor, a section through the combustion chambers and the gas turbine. A significant feature of the combustion chambers is their ability to burn Bunker C fuel oil although no details are given of the success achieved. I. G. B.

MISCELLANEOUS.

919. The Trend of Fuel Prices. Anon. *Motor Ship*, Apr. 1947, **28**, 10.—Bunker fuel prices quoted in shillings per ton are given for September 3, 1939 and March 1947 at various ports for two classes of fuel (fuel oil and diesel oil). An interesting comparison of the price differential between diesel oil and fuel oil at these two dates is given, diesel oil being 48% dearer than fuel oil in September 1939 and only 31·5% in March 1947. I. G. B.

920. United States Petroleum Industry in 1946. Anon. *Petrol. Times*, 12.4.47, **51**, 346.—Tables are presented of (1) United States production, imports, exports, stocks, and demands of refined products for 1946, and (2) United States crude-oil production by States and principal fields for 1946. Comparative figures for 1945 are also given. R. B. S.

921. Early History of The Bradford Field. G. G. Bauer. *Producer's Monthly*, Nov. 1946, **11** (1), 16.—An account is given of the history and development of the Bradford field from the discovery of the Drake well in 1859 up to the close of the century. R. B. S.

922. Canada's Contribution to Oil Production. Anon. *Petroleum*, 1947, **10** (2), 33.—A survey of Canadian oil production in recent years and its relation to production figures for countries inside the British Commonwealth as well as to those of other countries. K. C. G. K.

923. United Kingdom Petroleum Trade in December. Anon. *Petrol. Times*, 1.2.47, **51**, 125.—Tables are presented of United Kingdom imports and exports of crude oil and refined products for December 1946, together with comparative figures for December 1945. R. B. S.

924. United Kingdom Petroleum Trade in 1946. Anon. *Petrol. Times*, 1.2.47, **51**, 114.—Statistical data are presented on the United Kingdom imports and exports (including oil fuel bunkering of shipping) of crude oil and liquid refined products during 1946, together with comparative figures for 1945 and 1938. The total imports of crude oil and liquid refined products in 1946 was 3,806,064,000 I.G. as compared to 4,289,663,000 gal in 1945 and 3,203,505,000 gal in 1938. The gradual rise of petroleum imports since 1919 and the effect of the war on their general trend is shown graphically. R. B. S.

925. United Kingdom Solid Petroleum Products. Anon. *Petrol. Times*, 15.2.47, **51**, 174.—Statistical data are presented on the United Kingdom imports and exports of solid petroleum products during 1946, together with comparative figures for 1945 and 1938. R. B. S.

926. Shape of U.K. Overseas Trade Becoming Clear. Anon. *Petrol. Times*, 4.1.47, **51**, 19.—Tables are presented of United Kingdom imports and exports of crude oil and refined products for November and the eleven months of 1946. Comparative figures for 1945 and 1938 are also given. R. B. S.

927. United Kingdom Petroleum Trade in 1947 (Details for January). Anon. *Petrol. Times*, 15.3.47, **51**, 233.—Statistical data are presented on United Kingdom imports and exports of crude oil and refined products for January 1947, together with comparative figures for January 1946. R. B. S.

928. United Kingdom Petroleum Trade in 1947 (Details for February). Anon. *Petrol. Times*, 29.3.47, **51**, 287.—Statistical data are presented on United Kingdom imports and exports of crude oil and refined products for February and the first two months of 1947. Comparative figures for the corresponding periods of 1946 are also given. R. B. S.

929. Equipping the Oilfields. H. W. Lane and R. C. Thomson. *Times Rev. Ind.*, 1947, Apr., 6–9.—Considerable potentialities in the field of oil producing and refining equipment are available to British industry, although owing to the big lead by U.S. manufacturers American standards will have to be followed. A list of the main items of oil-producing equipment is given, showing which items are obtainable in the U.K. and which in the U.S.A. only. Features in the design of such equipment are briefly discussed, with particular reference to rock bits. Oil refinery equipment manufacture is handicapped by the lack of clad plate and by the fact that British prices are 25 to 100% higher than American. A plea is made for closer co-operation between the manufacturers of equipment for the oil industry and the oil industry itself. V. B.

930. Combustion in H.M. Navy. S. R. Dight. *Petrol. Times*, 26.4.47, **51**, 375.—The developments in the oil-combustion methods of the Royal Navy are reviewed. The improvements in boiler design are dealt with in most detail: the effect of these improvements on the construction and efficiency of fighting vessels is also discussed. R. B. S.

931. Sulphur from Sour Gas . . . An Added Income. G. Weber. *Oil Gas J.*, 8.3.47, **45** (44), 58.—A description is given of the process used by the McKamie Gas Cleansing Co., Arkansas, for the sweetening of extremely sour natural gas, with recovery of pure sulphur as a by-product. Operation over 3 years has proved practicable and profitable. In this period over 75,000 tons of sulphur, worth $1,250,000 has been recovered from the Dorcheat–Macedonia fields in South Arkansas. Briefly, the combined gases are "Girbotol" treated by contact with monoethanolemine solution at 100° F, and 650 p.s.i.g., yielding sweet dry gas from the column overhead and the extract from the base is then passed to a reactivator column at 225° F and 35 p.s.i.g., where the acid gas is stripped overhead, cooled, and passed to a modified Klaus process plant. Operating details of this section have not been published. The stream at this point contains about 55% H_2S, 43% CO_2, and 2% of hydrocarbon vapours, and is mixed with air and partially burned under air–gas ratio, controlled to the amount required to burn all the hydrocarbons and one-third of the H_2S. The stream is cooled to 530° F and is passed to the converter where it contacts bauxite and reacts as follows: $2H_2S + SO_2 = 2H_2O + 3S$, and passes to the catalyst chamber and to a sulphur wash column, and, again, through a second converter and a wash-tower. In each washer a stream of molten sulphur is circulated and from the base of each washer, the sulphur (at 250° F) produced flows out through a measuring tank before going to the sulphur storage pile. Operational problems are discussed and the peculiarities of melted sulphur are described. These show that temperatures must be controlled within 81° range to assure free operation of the liquid in the packed towers and lines. Several plants are discussed and briefly described, the first, completed in 1939, by the Lion Oil Co., Magnolia, treated 15,000,000 cu. ft./day of gas containing 1500 grains H_2S/100 cu. ft. Another plant treats 60,000,000 cu. ft./day gas from the Dorcheat–Macedonia field, containing 1900 grains/100 cu. ft. Information is given as to the organizations concerned, fields contributing, royalties contracted, and recovery figures. W. H. C.

BOOK REVIEW.

Gas Analysis and Testing of Gaseous Materials. V. J. Altieri, B.S. New York: American Gas Association, Inc. Pp. ix + 567.

In his Preface, Mr V. J. Altieri explains that the object of this book was to meet the needs for information on gas analysis of a variety of people—laboratory workers, chemists, physicists, and engineers, and also executives in the gas industry. Accordingly, the book includes a section on principles and methods for the pure and applied scientist, the principles being all connected with gas analysis and testing of gaseous materials. Detailed descriptions are given of methods for the measurement of quantity and flow of gas, of sampling, and of gas analysis by the apparatus due to Hempel, Orsat, Elliott, and Morehead and Shepherd. The book primarily deals with the methods adopted in the United States, and only briefly refers to the Haldane or Bone and Wheeler apparata.

One chapter deals with methods for the determination of small amounts of such gases as nitric oxide, carbon monoxide, oxygen, olefins, and sulphuretted hydrogen, and gives a description both of indicators and recorders. Liquefaction and distillation methods are also discussed, and methods for the examination of light oils obtained from gas and of the determination of naphthalene are also included.

In each chapter fairly full details are given and there is a comprehensive section dealing with the determination of density and specific gravity of gases, again including fairly full details of various types of specific gravity indicators and recorders.

The final chapter deals with the analysis of waste gases such as are obtained by the pyrolysis of coal, wood, shale, and other products.

There are seventeen pages of appendices, and very complete subject and author indices.

Referring again to the Preface, the author gives here a list of the large representative number of people who have been associated with him in the production of the book, which can be recommended to all interested in the investigation and testing of gas and gas analysis. F. H. G.

BOOKS RECEIVED.

Petroleum Production. Vol. II. The Optimum Rate of Production. Park J. Jones. New York: Reinhold Publishing Corpn., 1946. Pp. 293.

The Recovery of Vapours. Clark Shire Robinson. New York: Reinhold Publishing Corpn., 1942. Pp. 273.

Written with special reference to volatile solvents this book is intended to be a course of study in the basic theory of vapour recovery.

Conversion of Petroleum. A. N. Sachanen. New York: Reinhold Publishing Corpn., 1940. Pp. 413.

Relates to the fundamental principles and practices of converting petroleum into gasoline and other fuels.

Scientific Instruments. H. J. Cooper, editor. London: Hutchinson's, 1946. Pp. 293.

Modern scientific instruments are described by experts for the benefit of the non-specialist in five broad classifications: Optical, Measuring, Navigational and Surveying, Liquid Testing, and Miscellaneous.

B.I.O.S. REPORTS.

423. Appendix. Cyanide Research and Production at Degussa. Pp. 4.
590.* Deutsch Vacuum Oil A.G. Pp. 4.
1008. Rhenania Ossag A.-G., Hamburg. Fuels and Lubricants. Pp. 165.
1038. Ruhrchemie A.-G., Sterkrade-Holten, near Oberhausen, Ruhr. Pp. 14.
1118.* Final Report on the Investigation of the Use of Industrial Glassware for Chemical Plants in Germany. Pp. 4.
1142. Wintershall-Schmalfeldt Process for Manufacture of Synthesis Gas at Lutzkendorf. Pp. 40.
1143.* The Manufacture of α-Nitronaphthalene, α-Naphthylamine, and α-Naphthol at I.G. Farbenindustrie, Leverskusen. Pp. 27.
1144. I.G. Farbenindustrie. (1) Manufacture of Nitration Products of Benzene, Toluene, and Chlorobenzene at Griesheim and Leveskusen. (2) Manufacture of Aniline and Iron Oxide Pigments at Uerdingen. Pp. 33.
1181. German Carbon Industry. Pp. 93.
1193. Activities and Products of the firm of Bopp and Reuther G.m.b.H. Neckargemund with special reference to Fluid Flowmeters. Pp. 7.
1207. Shellac. Stroever & Co., Bremen. Pp. 9.

F.I.A.T. REPORTS.

629. Supercharged Loop Scavenging. Pp. 11.
667. Summary Report on German Automotive Engines. Pp. 25.
845. Research Reports on Benzyl Chloride, Xylylenechloride Triethanolamine, Triethanolamine Fatty Acids, Esters and Methylolacetophenon. Pp. 11.
945. Manufacture of γ-Butyrolactone at I.G. Farbenindustrie A.-G., Ludwigshafen. Pp. 13.
972. Manufacture of Chlorobromomethane Fire Extinguishing Agent "C.B." Pp. 8.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	246 A
Geophysics and Geochemical Prospecting	255 A
Drilling	260 A
Production	263 A
Oilfield Development	271 A
TRANSPORT AND STORAGE ...	272 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	273 A
Cracking	275 A
Polymerization	275 A
Alkylation	276 A
Special Processes	276 A
Metering and Control	276 A
Safety Precautions	276 A
Refining Patents	277 A
PRODUCTS.	
Chemistry and Physics ...	279 A
Analysis and Testing	281 A
Gas	284 A
Engine Fuels	284 A
Lubricants	285 A
Special Hydrocarbon Products	288 A
Derived Chemical Products ...	289 A
Miscellaneous Products ...	290 A
ENGINES AND AUTOMOTIVE EQUIPMENT	290 A
MISCELLANEOUS	291 A
BOOKS RECEIVED	294 A

AUTHOR INDEX.

The numbers refer to Abstract Numbers.

Adams, E., 1054
Aiken, C. B., 1013
Akins, D. W., 1026
Albright, R. E., 1131
Alcock, E. D., 984
Alexander, M., 1062
Ambrose, H. A., 1047
Anzus, L. I., 1067
Apjohn, T. L., 1131
Armistead, G., 1066
Arnold, C., 1072
Arnold, J. C., 1072
Aston, E. F., 1013
Aubert, M., 1107

Barthelmes, A. J., 983
Bauer, G. G., 1126
Beach, F. K., 1050
Beacham, C. C., 967
Beals, T. H., 1055
Belousov, V. V., 952
Bestougeff, M., 1086
Beyon, H. J., 1072
Bond, G. R., Jr., 1072
Boots, P. H., 968
Bornhauser, M., 944
Boyd, L. H., 964
Braddicks, R., Jr., 1095
Brancker, A. V., 1079
Brewer, A. G., 1013
Brooks, J. W., 1072
Buchdahl, R., 1095
Buddrus, E., 1047
Burk, R. E., 1072
Butyagin, P. J., 1077

Cagniant, P., 1068, 1102
Cahill, J. C., 1074
Caldwell, J., 1047
Calhoun, J. C., Jr., 1030
Campbell, D. L., 1072
Campbell, J. H., 1019
Cannon, G. E., 1013
Carney, S. C., 1047
Cejka, S. A., 1047
Chatelus, G., 1068
Clark, J. M., 1023
Clifford, I. L., 1072
Collins, D. B., 1047
Colomb, M., 1102
Cook, M. G., 1097
Corbin, N., 1063
Costin, W. B., 1013
Courter, L. A., 1013
Crane, F. S., 1013
Curado, J. G., 1095

Dana, F. E., 1047
Darmois, R., 1086
Davis, W. J., 1058
Dawson, H. M., 970
Deckert, H. B., 1013
Deegan, C. J., 1049
Delmarche, A., 1068, 1102
Derjaguin, B., 1108
Dix, O. H., 993
Dobbin, C. E., 946
Dow, R. B., 1110
Dresbach, C. H., 971
Dunigan, J. D., 1009
Dunn, J. H., 1122

Edwards, R. E., 1011, 1047
Egloff, G., 1082, 1125
Elovich, S. J., 1077
Eyring, H., 1111

Fagin, K. M., 998
Fawcett, E. W. M., 1072
Feacham, C. G. P., 1072
Fife, J. G., 1072
Filippone, W. R., 973
Flanagan, H. J., 1074
Flor De, J. G., 1061
Fowler, F. C., 1018
Frosch, A., 1013
Frowe, E. W., 980
Fu, C. Y., 986, 987, 988

Gabriel, V. G., 975
Garner, F. H., 1080
Gartin, E. G., 1013
Gillin, J. A., 984
Goldfinch, D. A., 1065
Graff, R. A., 1099
Grant, J., 1047
Gross, H. E., 1000
Gsovsky, V., 952
Gustafson, H. W., 1097
Guthrie, R. K., 1043

Halsey, G., 1111
Harris, S., 965
Heath, W. A., 1044
Hinson, H. H., 945
Holaday, W. N., 1131
Hoover, H., Jr., 996
Horton, A. A., 1072
Horton, A. W., 1072
Horton, C. W., 969, 977
Howe, H. V., 939
Hoylman, H. W., 991
Huetz, J., 1106
Hughes, C. H., 1072
Hughes, E. C., 1072
Hughes, R. V., 1037, 1038
Humphreys, C. J., 1076
Hunter, E., 1072

Jackson, W. J., 1022
Johnson, E. A., 1013
Johnston, D., 1001
Jones, E. N., 1016, 1027, 1029
Jones, P. J., 1039, 1040, 1041, 1042
Jordan, J. F., 1100
Joukou, V. A., 959

Keller, B. M., 962
Kendall, J. M., 985
Kilpatrick, J. E., 1075
Kintz, G. M., 989
Koepf, E. H., 1098
Kogbetliantz, E. G., 972
Kosygin, G. A., 934
Kothny, G. L., 1007, 1008, 1013
Koussakov, M., 1112
Krasnow, S., 1013

Langer, A., 1088
Lauenstein, R. L., 1021
Lawn, G., 1070
Lomer, T. R., 1084
Lowell, A. L., 1121
Luaces, E. L., 1072

McCarver, H., 947
McDowell, C. A., 1078
McKee, A. H., 968
Martin, W. F., 1017
Mayo, F., 1080
Ment, J. de, 978
Meyer, R. E., 1072
Meyerstein, W., 1094
Miller, E. F., 1131
Mitchell, R. G., 1073
Morgan, J. D., 1094
Morgan, J. S., 1013
Morris, G., 974
Mounce, W. D., 1013
Muffly, G., 982
Murphy, D. A., 1013
Murphy, E. T., 1074
Muskat, M., 1025, 1045
Myers, C. G., 1702

Narvarte, P. R., 992
Nelson, W. L., 1057, 1063, 1064, 1073, 1089
Nettleton, L. L., 942
Neubauer, R. T., 1060
Nichols, R. A., 941
Nielsen, R. F., 1051
Nissan, A. H., 1080
Norton, F. J., 1047

Offman, P. E., 960
O'Kelly, A. A., 1072
O'Leary, C. M., 1013
Osnipova, A. J., 958
Otto, F. B., 1072

Page, R. K., 1122

Parker, S. S., 1062
Patton, E. C., 1032
Peabody, G., 965
Peirson, J. G., 1120
Penn, W. S., 1115
Petrov, A. D., 1067
Peyton, G., 938
Pirson, S. J., 981
Pitzer, K. S., 1075, 1081
Plyer, E. K., 1076
Power, H. H., 1128
Pratt, W. E., 933
Price, P. H., 932
Probert, R. P., 1083

Quarendon, R., 1090

Reed, P., 937, 951, 1002
Reynolds, E. H., 1070
Richards, R. B., 1072
Richards, T. C., 974
Richardson, E. G., 935
Riske, T. H., 1100
Robinson, J. V., 1101
Roman, I., 995
Romberg, J. W., 1092
Rossini, F. D., 1074

Sachenen, A. N., 1072
Santiago, J. J., 1013, 1047
Savitz, C. W., 1013
Scrivener, W. C., 1013
Sedlak, V. A., 1074
Sewell, B. W., 1013
Shaw, M. C., 1060
Shelton, P. L., 1023
Shepherd, M., 1091
Short, E. H., Jr., 1003, 1005, 1010, 1046
Sigal, J., 953
Silverman, D., 1013
Sinn, V., 1087
Skeels, D. C., 979
Slezkin, N. A., 1104, 1105
Small, A. D., 963
Smith, E. A., 1113
Smith, N. C., 936
Smolianaky, M., 1108
Sneddon, R., 1051
Snodgrass, C. B., 1009
Stair, R., 1076
Stephenson, E. A., 1035, 1036
Sterrett, E., 1012
Strakhov, N. M., 955
Streiff, A. J., 1074
Strong, R. G., 1055
Sutton, A. N., 1127
Sutton, F., 1059
Swindells, J. F., 1096

Tait, H. C., 1072
Taliaferro, D. R., 1043
Targ, S. M., 1103, 1104
Taylor, J., 974
Taylor, M. O., 1025
Taylor, W. J., 1081
Theodorovitch, G. I., 961
Thompson, G. S., 1047
Todd, J. D., 940
Trautman, C. E., 1047
Traxler, R. N., 1092, 1093
Triggs, W. W., 1072
Troutman, W., 1070
Tuttle, R. B., 1071

Usines de Melle, 1072

Van den Minne, J. L., 1114
Van Thompson, 1099
Villey, J., 1107
Voronin, N. I., 957

Walsh, T. J., 1072
Watson, H. L., 1085
Watson, R., 950
Weaver, P., 971
Weber, G., 1024, 1033, 1048, 1116
Wendler, A. P., 966
Wengerd, S. A., 936
West, L. G., 947
West, T. S., 967, 1015
Whittaker, E. J. W., 1109
Widess, M. B., 990
Wiggins, J. H., 1059
Williams, E. G., 1072
Williams, F. J., 994
Williams, N., 998, 1020, 1034, 1049
Willingham, C. B., 1074
Wilton, T. O., 1072
Wolf, A., 976
Woolley, W. C., 997

Yanshine, A. L., 956
Yuster, S. T., 1047

Zaba, J., 999
Zimkin, E., 1072
Zobell, C. E., 1047

Oilfield Exploration and Exploitation.

Geology.

932. Evolution of Geologic Thought in Prospecting for Oil and Natural Gas. P. H. Price. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 673–697.—After a survey of the various uses of petroleum and natural gas from the earliest historical times, and even before, the beginning of the oil industry in the U.S.A. with the drilling of the Drake well is described.

For some time geologists and the oil industry worked independently of one another; but the oil-men's mistrust of geologists was dissipated by White and Orton, whose theories were first proved by the success of the well drilled at Mannington, West Virginia, in 1889.

As fresh uses for petroleum were found and the demand for it grew, ever greater efforts were made to locate oil and gas accumulations. A summary is given of the technical advances made up to the formation of the American Association of Petroleum Geologists in 1917.

As a result of the impetus given to the oil industry by the 1914–1918 war, large sums of money began to be devoted to research. The beginnings of palæontology and of the science of geophysics are described, and the use of aerial photography which was developed during the war is mentioned.

In conclusion, the principal modern trends of geologic thought are noted, including theories of origin, migration, accumulation, and reservoir traps. The most important advance since the anticlinal theory is stated to be the realization that reservoirs could exist without dip reversals due to deformation, and could result from a change in lithology, giving a stratigraphic type trap reservoir. The consequent complication of the science of petroleum geology called—and calls—for greater specialization; but this must be achieved without, if possible, a corresponding loss of integration. To preserve this integration is the task of the American Association of Petroleum Geologists. E. N. T.

933. Petroleum on Continental Shelves. W. E. Pratt. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 657–672.—The continental shelf can be considered as encircling all the continents except Antarctica in a continuous belt. Antarctica has its own individual continental shelf, which it shares with no other continent. The shelf is usually considered as extending to a depth of 100 fathoms or 600 ft; below it starts the descent into the deep oceanic basins.

The aggregate area of the continental shelves is about 11 million sq. ml. and represents

an extremely mobile segment of the earth's crust. It is considered that there are between 50 and 60 million cu. ml. of unmetamorphosed sediments which may contain more than 1000 billion brl of undiscovered oil or approximately 500 times the world's present annual consumption. These reserves are at present being tapped in only a very few localities off the coasts of the United States. It remains to be seen whether the petroleum reserves of the continental shelves will indeed be exploited on a large scale in view of the capital costs involved, particularly as processes of synthesis become increasingly economic. E. N. T.

934. Mechanism of Salt-Dome Formation. G. A. Kosygin. *Bull. Soc. des Naturalistes de Moscou*, 1945, *New Ser.*, **50**, *Sect. Geol.*, **20** (5–6), 3–29.—The low density of rock salt is of importance with regard to upward flow. Its plasticity and the fact that deeper burial does not significantly increase its compactness are further important features.

Salt-dome growth is a continuous process under the superincumbent load, and the rate is proportional to the height. The continuity of growth is shown by thickening of beds away from the dome. The shape tends to become more circular with growth. Uneven distribution of the cap-rock leads to irregular salt flow at the top of the dome.

The necessary difference in salt and sediment density may arise only after deep burial. Uneven load localizes the domes. G. D. H.

935. Measurement of Pressure on the Sea Bed. E. G. Richardson. *Phil. Mag.*, 1946. **37**, 25.—Details of the construction and calibration are given of an apparatus, based on the capacity and leak system, for measuring the pressure exerted by the sea on its bed. J. T.

936. Photogeology Aids Naval Petroleum Exploration. N. C. Smith and S. A. Wengerd. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 824–838.—The need for accurate information during the war has resulted in great developments in aerial photographic and interpretational techniques. In particular, photographic surveys were used by the U.S. Navy in the exploration of Naval Petroleum Reserve No. 4 in northern Alaska. The use of photogeology by the Navy in petroleum exploration is described and cited as an example of how this new science can procure preliminary geologic information with the minimum of time and personnel. E. N. T.

937. Fast Pace Being Set in Cotton County Development. P. Reed. *Oil Gas J.*, 23.11.46, **45** (29), 64–66.—The discovery well of the new Cotton County development was in the Essaquanahdale (Bridwell) pool where production was in the Houghton sand. The Cache Creek pool is 3 ml southeast, and the Soldier Creek (Johnson) pool 2 ml northwest. Initial outputs of wells have ranged 25–500 brl. Producing depths range 1300–1630 ft over the entire group. Drilling and completion of a well usually occupies 3 days. Drilling costs average $1.75–$2.00/ft. The wells are usually pumped separately by electric motors.

The development is along a buried northwest–southeast high. The proven area is 1700 acres, and recoveries may be 350 brl/acre-ft. The Walters field, 6 ml northeast of Soldier Creek, was opened in 1917. It produced from the Priddy sand. A few wells have been drilled to the Arbuckle, five being at Bridwell.

At Cache Creek an upper sand produces, and this same sand has a little gas at Essaquanahdale and Soldier Creek, but most production is from the lower Houghton sand. Both sands are in the Pontotoc (Pennsylvanian) and the top of the upper sand is about 200 ft below the base of the Permian. G. D. H.

938. Progress of Oil Search in Georgia. G. Peyton. *Oil Wkly*, 16.9.46, **123** (3), 92.—The northwest of Georgia is not viewed favourably for oil occurrence. Beneath the Coastal Plain are Triassic to Recent beds and over 9,000,000 acres have been leased in this area. Geophysical work has been carried out. The first adequate test went to granite at 4375 ft. Rocks ranging Miocene to Austin were met. In 1939 two shallow wells in Montgomery County had oil and gas shows. A shallow well in Clinch County had shows. Two wells in Dougherty County did not reach basement in 5000 ft, and one showed Claiborne to Tuscaloosa rocks. A well in Early County in 1943 found Wilcox to Lower Cretaceous, and Palæozoic rocks in drilling 7320 ft. Further deep wells were drilled in 1944.

Drilling has demonstrated the presence of Lower Cretaceous in Georgia at depth. Trias has also been found.

The deep wells are listed. A generalized geological map is included, together with an east–west section from Early County to Wayne County, and a generalized columnar section for the Coastal Plain. G. D. H.

939. Status of Micropalæontology in Eastern Gulf Region. H. V. Howe. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 713–730.—Although the larger fossils have been the object of frequent study since the time of John Finch, it is only since 1918 that the study of microfossils has been seriously developed. In the last 30 years, however, economic micropalæontology has been developed to a remarkable degree. Nearly 700 species of *foraminifera*, 150 of *ostracoda*, 580 of *bryozoa*, and 23 of *otoliths* have been described as new in the States of Mississipi, Tennessee, Alabama, Georgia, Florida, and South Carolina, while hundreds of other species have been reported whose type localities are elsewhere.

The formations whose type localities have been fairly thoroughly studied for their microfaunal content are listed, and suggestions for further studies are made.

A bibliography of over 200 papers on the subject is appended to this paper. Of these at least 160 deal mainly with *foraminifera*, 21 with *ostracoda*, 11 with *bryozoa*, and 4 with otoliths. Fossil species described as new in the region are listed in the bibliography. E. N. T.

940. What's Wrong With the Eastern Gulf Coast? J. D. Todd. *Oil Wkly*, 16.9.46, **123** (3), 89.—Florida has been a positive area above or just below sea level over long periods. The sinking which gave at least 38,000 ft of Late Tertiary in Terreborne Parish, has some influence on western Florida. There may be a few salt domes in western Florida under compact gravity minima.

Recent work has shown that the reflection seismograph encounters difficulties in the eastern Gulf Coast. This includes lack of reflections, acute velocity variations, and surface complexities.

40,000,000 acres are under lease in the eastern Gulf Coast area. Quite a lot of exploratory work has been carried out, but a few wildcats have been drilled. Source beds, reservoir, and cap-rocks seem to be present. The section probably has the same components as that of Texas, but in thinner development, and production may be found in the Eutaw, Tuscaloosa, Paluxy, and Smackover, and in the Palæozoic, if present. G. D. H.

941. Geothermal Gradients in Mid-Continent and Gulf Coast Oilfields. E. A. Nichols. *Petrol. Tech.*, Nov. 1946, **9** (6) (*A.I.M.M.E. Tech. Pubn. No.* 2114).—The bottom-hole temperatures of producing wells in the Mid-Continent and Gulf Coast oilfields were measured after being closed in for periods of 1 hour up to 10–12 days. In some instances the temperature recorded will not be the equilibrium value, although it will represent the temperature of value in application to producing reservoirs. The thermal gradient has been taken as the ratio of the temperature difference between the well bottom and the surface (assumed to be 74° F) and the depth. Accurate observations show that the gradient is not uniform, and that in most wells the curves increase in steepness with increasing depth. This is characteristic of areas underlain by sediments. Opposite curvature has been observed in areas believed to be closely underlain by granite or other igneous rocks.

1800 measurements were made in 194 fields, and the mean gradients have been plotted and contoured. The resultant map shows a low-gradient (0·3–0·8 F/100 ft) basin in the New Mexico–West Texas area. Higher gradients occur in the Gulf Coast area, and they increase inland. The general area of the Sabine Uplift is marked by a basin with the gradients decreasing towards the centre. G. D. H.

942. Geophysical History of Typical Mississippi Piercement Salt Domes. L. L. Nettleton. *Geophys.*, 1947, **12**, 30.—Maps and cross-sections are given, showing the development of geophysical and geological knowledge of the New Home and D'Lo domes. Both are shallow, piercement domes in the northern part of the Mississippi salt dome basin. Both were first indicated by gravity surveys, the shallow cap-rock checked by refraction seismograph surveys, cap-rock depths checked by drilling and further

seismograph work and drilling then carried out to determine the position of the salt and the attitude of the sediments. The successive items of geophysical work and test drilling have led to a consistent and orderly development of information about these domes.

An additional note is included, with three pairs of gravity maps, showing how strong and definite, but very local, gravity expressions of shallow domes may be missed by reconnaissance surveys. E. I. R.

943. Mississippian Oil in Permian Basin. Anon. *Oil Gas J.*, 2.11.46, **45** (26), 105.—1 Clark, about 8 ml north of Garden City, and on the east side of the Midland basin, was drilled to 10,970 ft, entering granite. The Ellenburger was met at 9840 ft. Production is from perforations at 9740–9755 ft in the Chapel limestone of the Mississippian. On test the flow was 238 brl/day of 56·5° oil, with a gas/oil ratio of 3878 cu. ft./brl. The closed-in pressure was 2334 p.s.i. This limestone produces on the Bend Arch farther east. G. D. H.

944. Marine Sedimentary Cycles of Tertiary in Mississippi Embayment and Central Gulf Coast Area. M. Bornhauser. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 698–712.—The principles of cyclic deposition are briefly reviewed and a tentative classification of marine sedimentary cycles is drawn up. These principles are applied to the Tertiary formations of the Mississippi embayment and the adjoining Gulf Coast area in Louisiana and Mississippi. At least five major cycles, representing incursions of the sea into this area, can be recognized, with a possible sixth in the Miocene section of the Gulf Coast area.

The presence of a submarine plateau in southeast Mississippi bounded by synclines on the north and northwest, is indicated by the facies and thickness distribution of the older Tertiary cycles. A study of three attached isopachous maps shows a progressive expansion of this positive area to the north and northwest during Eocene time, as the bordering synclinal areas shifted in the same direction. This expansion can be explained by the theory that the southeast Mississippi plateau is part of the northern front of the Gulf of Mexico neutral plate, which possibly drifted northwestward in connection with the Tertiary orogenic movements in the Greater Antilles.

The various marine transgressions during the Tertiary are ascribed to epeirogenic movements in the Mississippi embayment and its border-lands. These movements reached their climax in Jackson time, after which the sea retreated finally from the Mississippi embayment. E. N. T.

945. Reservoir Characteristics of Rattlesnake Oil and Gasfield, San Juan County, New Mexico. H. H. Hinson. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 731–771.—The Rattlesnake oil and gasfield is in the Navajo Indian Reservation about 7 ml southwest of Shiprock, in San Juan County, northwestern New Mexico, near the northwest edge of the San Juan Basin.

The structure of Rattlesnake is a northwest–southeast-trending anticline, with a series of minor highs along its axis. The anticline has greater structural relief with depth, and the lower beds thin over the top of the structure. The dip of the older rocks is much greater on the west flank of the structure than on the east flank. The axial plane of the anticline is progressively farther west with depth, and the apex of the anticline is progressively farther south with depth.

The thickness of the sedimentary rocks penetrated by wells on the Rattlesnake field is about 7500 ft. At the surface is the Mancos shale (700–800 ft), which all wells penetrate. Under this is the Dakota sandstone, which is about 200 ft thick and from which most of the oil which has been produced, and all the oil being produced at present in the Rattlesnake field have come. Underlying the Dakota sandstone are several non-oil-bearing formations: the Morrison formation, the San Rafael group, containing several formations, the Wingate formation, the Chinle formation, the Shinarump conglomerate, the Moenkapi formation, and the Cutler and Rico formations. Below the Rico formation, at depths of approximately 5700 to 5800 ft is the Hermosa formation, with a thickness varying from about 1050 to 1200 ft. This formation has produced oil in the Rattlesnake field from two wells. Lower identified strata are the Molas formation, the Ouray limestone, which forms a reservoir for helium-bearing

natural gas, the Elbert formation and the Ignacio quartzite which, being Upper Cambrian in age, is the oldest formation reached.

Oil was found in the Dakota sandstone in February 1924. By 1944 over 100 wells had been drilled, and about 36 were still producing in the field. This oil, which is highly volatile, may have a gravity as high as 76° API when fresh, but quickly weathers to a gravity of about 60° to 64° API. Up to the end of 1945, the Dakota sandstone had produced 4,321,753 brl of oil.

Commercial production was obtained from 2 wells in the Hermosa formation. Between them they produced, from two separate porous zones, 489,563 brl of oil between 1929 and 1940.

Although helium-bearing natural gas was found in the Ouray–Leadville formation in June 1942, the first gas well was not completed until a year later. The composition of this gas is very unusual because of its high nitrogen content. The helium content is also high, and in consequence this gas pool is being held as a helium reserve by the Bureau of Mines, U.S. Department of the Interior. E. N. T.

946. Exceptional Oilfields in Rocky Mountains Region of United States. C. E. Dobbin. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 797–823.—Oil accumulations in the Rocky Mountain area have a wide range of qualities and vary considerably in their geological occurrence. This paper deals with representative fields of this area that produce oils of highly divergent character under relatively exceptional conditions. Oil ranging in gravity from 11° to 76° comes from all varieties of traps in Lower Mississippian to Oligocene reservoir rocks. The fields described include domes, stratigraphic traps, highly folded anticlines, faulted domes and anticlines and, lastly, non-faulted anticlines and domes. Oil from pre-Jurassic strata is generally heavy while that from younger strata is generally light, facts which in the main are contrary to conditions elsewhere. It is pointed out that the conditions of oil accumulation in the Rocky Mountain region have in many cases not been satisfactorily explained. E. N. T.

947. Geology and Geophysics of the Odem Oilfield, San Patricio County, Texas. H. McCarver and L. G. West. *Geophys.*, 1947, **12**, 13.—The early exploration of the Odem area by geological, torsion balance, and seismograph methods was followed in 1938 by a reflection seismograph survey. On the basis of this later work the discovery well was drilled in 1939. The proven limits of production conformed closely to the contours of the seismograph map. E. I. R.

948. Oil Resources of South America. Anon. *World Petrol.*, Dec. 1946, **17** (13), 54.—Reserves estimates for South America have been made as follows: 3,700,000,000 brl (Garfias, 1939), 5,200,000,000 brl (Bateman, 1942), and 7,000,000,000 brl (Gester, 1944). Oppenheim has suggested a limit of 30,000,000,000 brl.

There are vast areas of former marine basins. Large areas of Argentina are untested, and these include the Santa Cruz and Magellanes basins of the south, the great Chaco basin of the north, and the area along the Andean front ranges.

Most of Chile is geologically unfavourable, but seeps have been found south of 52° latitude. Shallow wells have found small accumulations, and there are 12 structures on Tierra del Fuego. A wildcat has found commercial production at 7428 ft. Uruguay has one interesting sedimentary basin. No production has been found in Paraguay, but favourable structures may extend into this country from Argentina and Bolivia. Bolivia has three fields, and has not been adequately tested. The territory of Acre is viewed favourably. It has a Cretaceous Tertiary sequence like that of the Agua Caliente field. The petroleum possibilities of the Amazon basin are unknown, only a few tests having been made in the Devonian section. The Permian Iraty shales of the Parana basin are undoubtedly source rocks. The outer part of the basin is overlain by 2000 ft of lava.

Further developments are possible in the Agua Caliente region and also in northwest Peru. The former area is very difficult of access. There are oil-possibilities east and west of the Andes in Ecuador. Favourable structures have been located in the east, and there is a thick Tertiary sequence. The Llanos of Colombia may prove oil-bearing, and other areas outside the Magdalena valley may give production. Many areas in eastern and western Venezuela will ultimately give oil.

At present thirteen major geological areas are giving oil in South America. 90%

of the production is from the Tertiary, the rest is mainly from the Cretaceous. Source rocks are known chiefly in the Tertiary, and to a less extent in the Cretaceous and Devonian. Folds and stratigraphic traps provide the chief sites of oil accumulation.

A map shows the main petroliferous basins and the principal oilfields. G. D. H.

949. Oil Strike Reported in Third Chilean Well. Anon. *Oil Gas J.*, 9.11.46, **45** (27), 40.—No. 3 Spring Hill is now giving high-grade oil after first giving gas alone.

G. D. H.

950. Development of Amana Field in Venezuela. R. Watson. *Petrol. Engr*, Oct. 1946, **18** (1), 93.—The first producer at Amana was drilled in 1928, oil being found at 4100 ft. The second producer, Amana No. 3, was drilled to 5300 ft, and production was obtained from two Eocene sands between 3188 and 3955 ft. 31° API oil was produced at 400–500 brl/day. G. D. H.

951. Exploration of Orinoco Delta Fraught with Difficulties of Terrain and Climate. P. Reed. *Oil Gas J.*, 14.9.46, **45** (19), 64.—The oil possibilities of the Orinoco Delta have long been known from seeps, asphalt lakes, the wells at Pedernales, the proximity of the Trinidad oilfields, and the presence of a great thickness of sediments. However, the swampy area with its many difficulties has deterred oil companies. Richmond proposes to make a seismic survey. Experience shows that deep piles may be needed for well foundations. Boats and marsh buggies are essential. Some seismic work has been done.

Beneath the Recent and Pleistocene formations of the delta there are believed to be 8000 ft of Tertiary sandstones and limestones possibly resting on Cretaceous limestones which overlie the basement.

Pedernales has produced over 9,000,000 brl of oil from depths of 5000–6000 ft.

G. D. H.

952. Geosynclines, Their Structure, History, and Laws of Development. V. V. Belousov and V. Gsovsky. *Bull. Soc. des Naturalistes de Moscou*, 1945, *New Ser.*, **50**, *Sect. Geol.*, **20** (5–6), 130–164.—During Cambrian and Ordovician times the Caledonian geosyncline of the British Isles was divided into four subsidiary geosynclines, each up to 100 km wide—the North Scottish, Girvanian, and Ettrick Bridge geosynclines ran northeast–southwest, and the southernmost geosyncline was curved, being convex to the southeast, and having the Lake District at its northern end where there may have been a connection with the Ettrick Bridge geosyncline. A geanticline from South Wales to the Pennines separated the Welsh depression from the Brabant geosyncline. The Lewis uplift separated the north Scottish depression from other geosynclines which may have lain in the Atlantic area to the northwest. The depressions sank and extended during the Cambrian and Ordovician, while the intervening uplifts were denuded.

The lower beds (Cambrian) are chiefly clastics, but the Arenig and Lower Bala have rocks of volcanic origin. Limestones appear in the Upper Bala. In the Upper Llandovery new areas of uplift and denudation appeared in the central parts of some of the former downwarps, and around these thick series of flysch sediments were formed. At the same time old geanticlines were submerged. The central uplifts expanded and at the beginning of the Devonian the earlier geosynclines had disappeared. Outward migration of the peripheral downwarpings led to submergence of former geanticlines. The growing mountains provided a large volume of coarse clastics, which at times exceeded the rate of sinking in submerged areas, leading to extensive formation of continental deposits. In the downwarps there were some volcanic outpourings.

The zone of folding moved with the expansion of the central uplifts. After the Caledonian diastrophism the geosynclinal area of the British Isles was replaced by a geanticline.

The Caledonian geosyncline of the British Isles differs from other geosynclines in its weak folding, absence of overthrusting, absence of batholiths in the cores of the anticlinoria, absence of internal depressions due to sinking of the vaults of the anticlinoria, and the small amplitude of the post-inversion uplift of the subsidiary geosynclines.

G. D. H.

953. Study of the Micro-Fauna of the Gensac Field (Haute-Garonne). J. Sigal. *Rev. Inst. franç. Petrole et Ann. des Comb. liq.*, Oct. 1946, **1** (1), 16–32.—Gensac lies 20 km northwest of Saint-Gaudens. Small outcrops of Maestrichtian and Danian occur surrounded by Mio-Pliocene and Quaternary. 3 wells have been drilled, No. 1 and No. 3 being near the axis of the structure, and No. 2, 1·5 km away. No. 2 had a considerable number of cores, especially below 800 m.

The cores were treated in order to recover the micro-faunas, consisting of *foraminifera* and *ostracods*. A series of charts have been constructed showing the distribution and degree of abundance of various genera, while diagrams have been prepared showing the proportion of various species of *Globotruncana* at different depths in No. 2. Studies of the species of the latter confirm the deductions drawn from studies of the entire fauna. G. D. H.

954. Post-war Development Progressing in Holland's Coevorden Field. Anon. *World Petrol.*, Nov. 1946, **17** (12), 66.—Traces of oil were found in Holland in 1923 in sinking a shaft to the Coal Measures at Winterswijk.

A gravimetric survey of the northeastern provinces was followed by a dozen coreholes about 1300 ft deep. These showed a broad structure west of Coevorden.

In 1939 the Germans discovered a gasfield in the Zechstein on an east–west structure near Bentheim.

Further gravimetric work was undertaken, together with refraction work and core drilling, in an area which extended as far west as Delft. The Germans discovered an easterly continuation of the structure known west of Coevorden. In 1942 a second well was commenced 5 ml east of Coevorden, and in 1943 this cored a thin oil zone in the Portland at 2900 ft. The well went to 4172 ft in the Lias. A small amount of oil was pumped from this well. The Germans drilled a well near Emlichheim and in 1943 this was reported to have produced heavy oil at the rate of 240 brl/day from a 100-ft sand topped at 2560 ft. A well on the north flank found 90 ft of fine loose oil-saturated oil sand and was capable of flowing, but rapidly declined due to wax and sand in the tubing. The Germans had completed about 7 wells at the time of the collapse in 1945. In May 1946 there were eight producers and two failures.

Dips are gentle and faults numerous. The limits of the field are known in the west.

The crude is highly paraffinic and viscous. In May 1946 the daily output was 760 brl. The German part of the field was reported to produce 350 brl/day.

A well in Holland west of the Bentheim gasfield has found only doubtful traces of gas, but has not reached the Zechstein. G. D. H.

955. On the Comparative Lithological Method and its Urgent Tasks. N. M. Strakhov. *Bull. Soc. des Naturalistes de Moscou*, 1945, *New Ser.*, **50**, *Sect. Geol.*, **20** (3–4), 34–49.—A comparison of ancient sediments with each other and with recent sediments allows the formation of ideas about specific features in the past history of the earth, and the evolution of the earth.

Important tasks awaiting attack by the methods of comparative lithology include the accumulation of data concerning sediments and sedimentation in modern seas, especially in the shelf zones, studies of deposition in the Caspian, the Black Sea, and lakes in arid zones, such as Balkash and Kulundinskye. A consistent description of ancient sediments and of their mode of formation is required. G. D. H.

956. On the Buried Hercynides Eastward from the Caspian. A. L. Yanshine. *Bull. Soc. des Naturalistes de Moscou*, 1945, *New Ser.*, **50**, *Sect. Geol.*, **20** (5–6), 30–54.—Gravimetric data in western Kazakhstan reveal a strip of positive anomalies running north from Mangyshlak, across the Buzachi peninsula and the northern part of the Ustyurt plateau. In the east it is connected with a strip of similar anomalies of the Sultan-Uiz-Dag range and other ranges of the south Tian-Shan. On the basis of these data it was supposed that buried Hercynian ranges connecting the Tian-Shan with the European Hercynides pass through the Ustyurt and the Buzachi peninsula.

Coarse deposits in the Permian, Triassic, and Jurassic suggest that the area undergoing denudation lay between Mangyshlak and the Emba region, for the former was an area of deposition. Upper Jurassic and Lower Cretaceous facies again indicate a strip of land between Mangyshlak and the lower part of the Emba. The land was submerged from Turonian times onwards.

The nature of the rocks in the buried strip of Palæozoic is shown by pebbles in the Permian and Mesozoic of Mangyshlak and the Emba region. There are quartzose rocks, crystalline schists, igneous rocks, and micaceous sandstones. The Albian rocks of eastern Mangyshlak have rounded fragments of argillaceous schists with remnants of Lower Carboniferous fossils.

Most of the Permian and Triassic exposures of Mangyshlak show northwest–southeast folds, while the Tertiary folds are more nearly east–west. The general position of the buried strip of Palæozoic seems to correspond with the oldest strikes of Mangyshlak. Farther south other strips of folded Palæozoic lay.

The Hercynides of the Mugodjars and the buried Hercynides between Mangyshlak and the Emba region represent two branches of the Palæozoic system of the south Tian-Shan. G. D. H.

957. Geological Structure of the Don-bend. N. I. Voronin. *Bull. Soc. des Naturalistes de Moscou*, 1945, *New Ser.*, **50**, *Sect. Geol.*, **20** (3–4), 72–95.—Palæozoic beds are exposed in the core of the gentle north–northeast striking anticline of the Don-bend. Mesozoic beds occur on the flanks. The western limb of the anticline has a complication in the form of a sharp subsidiary syncline which passes into a flexure and a fault. There is a lower series of limestones, calcareous breccias, clays, marls, and sandstones, some of these beds being of the Uralian division of the Carboniferous. Overlying these transgressively are a conglomerate and variegated sandy clays, and sandstones with silicified wood. The succeeding beds consist of sands, clays, glauconitic sands, chalk and chalky marls, and grey clays.

The Carboniferous beds have been correlated with similar beds on the river Archeda. G. D. H.

958. Upper Palæozoic Flysch of the River Juriazan. A. J. Ossipova. *Bull. Soc. des Naturalistes de Moscou*, 1945, *New Ser.*, **50**, *Sect. Geol.*, **20** (3–4), 111–119.—The fusulinid fauna of the section described permits its assignment to the horizon of *Pseudofusulina moelleri* Schellw. The section is exposed on the right bank of the Juriazan at Moussatova. Its thickness is great, discordances are lacking, the sedimentation is rhythmic, and the amounts of different types of deposits are limited. The fauna is poor, and includes *ammonites, nautiloids, pelecypods, bryozoa*, and *fusulinidae*. Specimens of the first three types occur in the clays and concretions, while *fusulinidae* and *bryozoa* are found in the limestones which at times replace the sandstones of the first phase of the rhythm. Hieroglyphs and ripple marks are present, and remains of terrestrial vegetation. The mineral grains are poorly rounded, and the felspars are fresh, pointing to little transport.

Each rhythm consists of three parts. At the base are small or medium sand grains. There is a gradual passage to the second part with fine sandstones and then to the third part marked by calcareous clays. At times the rhythm is incomplete, the first or second part being absent. Occasionally the first part is marked by fusulinid limestones. The change from the third part to the first indicates a marked change in conditions of sedimentation; often the surface of the clay is irregular due to interruption in sedimentation. The rhythm is not seasonal, for the thickness is too great; variations in the sun may be the cause. Nevertheless, the full section was probably formed rapidly for the quickly evolving ammonites and fusulinidae show the same types throughout. G. D. H.

959. Tectonics and Structure of the Moscow Palæozoic Depression. V. A. Joukou. *Bull. Soc. des Naturalistes de Moscou*, 1945, *New Ser.*, **50**, *Sect. Geol.*, **20** (5–6), 74–92.—The axis of the depression first runs southwest–northeast and then turns along the Timan foothills running north and northwest to Tchesh skaia Bay on the Kanin peninsula. The axis is readily shown by the Triassic, Jurassic, and Cretaceous deposits in the interior of the basin. The northern limits of the basin are marked by outcrops of crystalline and Cambrian rocks on the Kanin peninsula.

The broad synclinal structure of the Moscow basin is modified by local uplifts and depressions, the trends of which are generally parallel to the axis of the main depression. The Oka–Tsna high is between the Riazan–Kostroma and Moksha–Oka downwarps in the southern part of the basin; in the northern part are the Soligalitch-Sukhona high, the Viatka high with the Tcheboksary downwarp, and the Viatka and

Sysolsk–Vytchegodsk highs. The amplitude of these features may amount to 200 m. The core of the Oka–Tsna feature consists of Middle and Upper Devonian beds resting directly on the crystalline basement. Carboniferous and Permian deposits overlie the Devonian.

There is evidence that the sinking of the Moscow basin had begun in Middle Devonian times, and reached its maximum rate in Upper Devonian times, and continued with less intensity into the Mesozoic. The area of most rapid sinking varied with time. Local downwarps and highs are possibly associated with basement faults. G. D. H.

960. Ground Features of the Middle Timan Structure. P. E. Offman. *Bull. Soc. des Naturalistes de Moscou*, 1945, *New Ser.*, **50**, *Sect. Geol.*, **20** (5–6), 55–73.—The base of the Timan structure consists of metamorphics, and above are Devonian and Carboniferous formations. The structure rises above the adjacent synclines. The Upper Palæozoic shows steps going down to the synclines. There are indications that the structure is largely due to vertical movements. Small domes frequently occur on the steps, and oil and gas are associated with them. G. D. H.

961. Replacement Dolomites in the Upper Palæozoic of the Ural and Volga Regions. G. I. Theodorovitch. *Bull. Soc. des Naturalistes de Moscou*, 1945, *New Ser.*, **50**, *Sect. Geol.*, **20** (3–4), 105–110.—Replacement dolomites take the place of microgranules of calcium carbonate. Most dolomitic limestones are characterized by idomorphism of the dolomite rhombohedra which are of almost uniform size, especially in cases of incomplete dolomitization. When there is complete dolomitization the dolomite rhombohedra are imperfect.

Based on internal structure the following types of replacement dolomites can be distinguished: (*a*) homogeneous grains, (*b*) grains with a purer margin (*c*) grains with a core, (*d*) zoned grains, and (*e*) grains with inclusions in the peripheral zones.

Primary dolomitic grains can be recognized, as well as those formed in consolidated deposits. The degree of idiomorphism of grains of dolomite is a function of the extent of consolidation in the sediments dolomitized. G. D. H.

962. Tectonics of Uralian Karataou and the Oil Zone of Kasayak. B. M. Keller. *Bull. Soc des Naturalistes de Moscou*, 1945, *New Ser.*, **50**, *Sect. Geol.*, **20** (5–6), 93–114.—The Karataou uplift lies in the basin of the Sym and Jouriazan rivers. Internally it shows a series of fractured brachy-anticlines. The northwest part is simple in structure having only two monoclinal blocks. The uplift is due to vertical movements which led to great fractures around the margin and break up the central part. Movement began in Permian times.

South of the Karataou uplift is the pre-Ural depression and the edge of the Russian platform, the two principal features of the northern Ural area. At the edges of these two zones are Lower Permian reefs, which are believed to be connected with brachy-anticlines. When highs crowned by reefs lie in subsiding areas they are of special interest from the point of view of oil accumulation. At the base and between the reefs are thin marly limestones and dolomites. This is contrary to many beliefs concerning sinking areas. G. D. H.

963. China—Its Future in Petroleum. A. D. Small. *Petrol. Engr*, Oct. 1946, **18** (1), 98.—In Taiwan geophysical exploration of alluvium-covered areas will be necessary. Beds of Tertiary age are present. Of seven structures tested three have produced oil commercially—Shikukoko, Kinsui, and Chikutozaki. These structures, together with Chikuto, Gyuzan, Rokusyukei, and Toshikyaku are in the foothills of the mountains. The steeper folds have dips of 70–80°, and the gentler folds 30–35°. 224 wells have been drilled and 143 have produced oil or gas. The deepest test was 9900 ft. The three producing structures have averaged 2500 brl of oil/month and 193,609,390 cu. ft. of gas/month, from 1936 to 1945. Each field has three to seven producing sands of low porosity and permeability. Thicknesses range 30–140 ft.

The main exposures in the Szechuan basin are Cretaceous, with older beds on the uplifts. Oil has been noted in the Cretaceous (especially lower), the Upper and Lower Jurassic, and the Upper Triassic. About a hundred anticlines have been mapped, mainly in the east and south. Shikyoukou No. 1 is on a north–south anticline which has easterly dips of 15° and westerly dips of 35–55°. It is about 25 ml long and 7 ml

wide. A seepage of oil occurs. The well was completed in a Triassic limestone at 3690 ft, and on test gave 500,000 cu. ft. of gas per day.

Shentengshan No. 2 gives gas from the Trias at 2468 ft. The anticline trends northeast–southwest, is 7 ml long and 2 ml wide; and has flank dips of 10–16° to the southeast and 15–36° to the northwest. The flow was 5,000,000 cu. ft./day.

A test is being drilled on the Kiaugyu structure where there is an oil seep.

The folds of the Kansu basin are in Tertiary beds. Much of the centre of the basin is covered with thick Quarternary deposits. An oilfield has been developed at Laochunmiao where there are seeps. 26 wells have been drilled since 1939. A number of producing sands occur. Some 12 wells are averaging 120 brl/day each. The producing area may cover 1375 acres, and the reserves may be 89–100 million brl. The oil is very waxy. It is likely that the Wenchushan and Minho structures will be tested.

G. D. H.

Geophysics and Geochemical Prospecting.

964. Gravity-Meter Survey of the Kettleman Hills–Lost Hills Trend, California. L. H. Boyd. *Geophys.*, 1946, **11**, 121.—Maps from a gravity survey over the Kettleman Hills–Lost Hills Area are compared with previously published subsurface contours and cross sections. These show that the three Kettleman Hills Domes each produce a strong and definite gravity high while the Lost Hills Anticline produces a very clear and closely corresponding gravity low. The paper points out the probable cause of this unusual feature as being a transition within the Reef Ridge Formation from punky, diatomaceous shale at Lost Hills to clays and sands at Kettleman Hills. E. I. R.

965. Refraction Exploration in West Texas. S. Harris and G. Peabody. *Geophys.*, 1946, **11**, 52.—A brief historical account of the development of the refraction technique is given in this paper. The differences between the earlier methods and the modern correlation methods (as used in West Texas) are clearly explained. E. I. R.

966. Geophysical History of the Lovell Lake Oilfield, Jefferson County, Texas. A. P. Wendler. *Geophys.*, 1946, **11**, 302.—The following geophysical surveys lead to the drilling of the discovery well of the Lovell Lake oilfield in 1938: torsion balance 1929, refraction fan shooting 1929, reflection seismograph 1933, 1935, and gravity meter regional survey 1936. The results of these surveys and a detailed reflection seismic survey carried out in 1938 after the discovery well had been drilled, are given.

E. I. R.

967. A Resistolog Survey of the Loma Alto–Seven Sisters Area of McMullen and Duval Counties, Texas. T. S. West and C. C. Beacham. *Geophys.*, 1946, **11**, 491.—The authors claim that the electrical properties of the deep horizons can be determined more accurately by their Resistolog Method as the effect of shallow inhomogeneities are eliminated by this procedure. The principle of the method and the results of an experimental survey over the known Loma Alto–Seven Sisters fields are given.

E. I. R.

968. Geophysical Operations in Kuwait. P. H. Boots and A. H. McKee. *Geophys.*, 1946, **11**, 164.—This paper describes a geophysical survey that was successful in discovering oil in Kuwait on the Persian Gulf. Gravimeters and Schmidt vertical magnetometers were used for reconnaissance purposes and the reflection seismograph for detailed work in selected areas. The organization of the party, speed of working in an unexplored area, and the manner in which the operations were adapted to suit the climatic conditions and customs of the people are dealt with. The geophysical results, however, are not included. E. I. R.

969. Interpretation of Isostatic Anomalies South of Java, Using Integral Equations and Crustal Deformation Theories. C. W. Horton. *Geophys.*, 1946, **11**, 183.—The gravity measurements of Vening Meinesz show the existence of a symmetric belt of negative gravity anomalies south of Java. The mass distribution on a surface 40 km deep which will explain the observed anomalies is determined by means of an integral equation. This mass distribution is interpreted as resulting from the deformation of

a crust normally 40 km thick. Some comments are also made on Gunn's theory of mountain formation. E. I. R.

970. Planning of a Foreign Geophysical Operation. H. M. Dawson. *Geophys.*, 1946, **11**, 435.—The vital questions of advance preparation, equipment required, and supply system for foreign geophysical operations are thoroughly discussed. In particular, the author stresses the importance of having the area thoroughly inspected by a competent and experienced man before the details of the exploration programme are considered. E. I. R.

971. Review of Geophysical Methods, Devices, and Procedures. C. H. Dresbach and P. Weaver. *Oil Gas J.*, 2.11.46, **45** (26), 79.—In every part of U.S.A. where there are oilfields geophysical prospecting has been tried. At first geography alone led to the choice of territory and no attention was paid to the suitability of the geophysical method to the type of structure involved, and therefore the initial work was frequently disappointing. On the Gulf Coast where the search was for salt plugs the gravity and refraction methods were suitable and the finding rate was good. Elsewhere progress was not satisfactory until the appropriate method was employed. G. D. H.

972. Estimating Depth and Excess-Mass of Point-Sources and Horizontal Line-Sources in Gravity Prospecting. E. G. Kogbetliantz. *Geophys.*, 1946, **11**, 195.—This paper gives solutions for the point- and line-mass gravitational anomalies. The determination of the depth, total excess mass, and error in the regional datum assumed are determined from the observed anomaly by the use of moments of gravity. E. I. R.

973. Depth-Displacement Slide Rule. W. R. Fillippone. *Geophys.*, 1946, **11**, 92.—A slide rule is described, based on formulæ for circular arc ray paths, to compute depth and displacement of seismic reflectors when time of reflection, angle of dip and velocity-depth distribution are known. The rule may be used to compute horizontal and vertical displacement for reflectors on point-plotted sections if dips do not exceed 15°. An alternative is a modification of a standard log–log trig slide rule, which serves the same purpose. E. I. R.

974. The Effect of Velocity of Detonation on the Efficiency of Explosives Used in Seismic Prospecting. J. Taylor, G. Morris, and T. C. Richards. *Geophys.*, 1946, **11**, 350.—Field tests have shown that no significant difference in amplitude or frequency of the first arrivals of refracted waves at distances from 6000 to 20,000 ft, is found from explosives having velocities of detonation in the range 7500 to 1100 m/sec or powers from 61% to 85% blasting gelatine. When a deflagrating explosive was employed there was only a very small decrease in the amplitude of the refracted wave. E. I. R.

975. Electrical Methods in Oil Exploration. V. G. Gabriel. *Petrol. Engr*, Oct. 1946, **18** (1), 216.—There is a wide variation in rock resistivity depending on the lithology and on the age of the rocks. This renders interpretation difficult. Jointing and compression may also influence the electrical properties, and electrical anisotropy may be present. The degree of cementation affects the porosity and with it the resistivity, and the nature and amount of fluid in the pores is of great importance in this connexion. The temperature gradient also is important, and burial to 6000 ft may halve the resistivity.

It has been concluded that a comprehensive three-dimensional analysis of the results of electrical measurements is not yet practicable.

Claims for the direct detection of oil-bearing rocks by electrical methods have been made to a maximum depth of 6000 ft. These claims are based on resistivity differences between productive and non-productive sands, and on comparison with observations in known oilfield areas.

The presence of recognizable electrical key horizons in many areas makes electrical methods valuable in the search for favourable oil structures. Electro-magnetic and radio-frequency, and improved electrical transient techniques may prove to be of value in investigations. G. D. H.

976. Electric Field of an Oscillating Dipole on the Surface of a Two Layer Earth. A. Wolf. *Geophys.*, 1946, **11**, 518.—The electric field of a low-frequency oscillator placed on the surface of a two-layer earth is determined in two special cases, namely, the case in which the conductivities of the two layers are nearly equal, and the case in which the lower layer is a perfect insulator. E. I. R.

977. On the Use of Electromagnetic Waves in Geophysical Prospecting. C. W. Horton. *Geophys.*, 1946, **11**, 505.—An approximate analysis of the behaviour of electromagnetic waves in a conducting medium is given. The approximations consist of replacing pairs of electrodes by dipoles and of using only the first order images in the case of a layered earth. It is shown that under certain conditions one can measure the depth of an electrical interface 6000 ft deep by means of electromagnetic waves. It is further shown that even a thin layer of salt water or oil-bearing sand at a depth of 6000 ft gives an effect that is easily measurable. E. I. R.

978. Fluorescent Techniques in Petroleum Exploration. J. de Ment. *Geophys.*, 1947, **12**, 72.—New methods of petroleum location, detection, and analysis, based on the fluorescence characteristic shown by all crude oils are described. A brief review is given of the available techniques and instruments used in fluorochemical analysis, and emphasis is placed on fluorographic exploration by means of sub-surface soil samples, as well as the fluorologging of wells. The author has not limited himself to a review of the field, but has also pointed out, on the basis of the existing data of fluorochemistry, approaches to problems in the petroleum field which have proved successful in other branches of radiation science. A very complete list of references is given. E. I. R.

979. Ambiguity in Gravity Interpretation. D. C. Skeels. *Geophys.*, 1947, **12**, 43.—It is shown that contrary to what is stated and implied in much of the literature, gravity and magnetic data cannot, of themselves, be interpreted uniquely. It is shown by means of a two-dimensional example that for a given anomaly and a given density contrast a wide range of possible interpretations can be made, at various depths, and that whereas there is a maximum depth for the solution the minimum depth is zero. E. I. R.

980. Diving Bell for Underwater Gravimeter Operation. E. W. Frowe. *Geophys.*, 1947, **12**, 1.—The recent development of a diving bell, designed to carry a gravimeter and observer, enables the geophysicist to make correct gravity observations on a river, lake, or ocean floor. The structural features and related equipment of a bell designed to operate in depths of water up to 250 ft are described. Data taken from adjacent land and sea areas have been contoured and the smoothness of these contours indicates that the underwater gravity readings are entirely reliable. E. I. R.

981. Disturbing Factors in Geochemical Prospecting. S. J. Pirson. *Geophys.*, 1946, 11, 312.—A review of the results of over 3000 measurements of soil ethane emanation rate made over the past 5 years has revealed a number of conclusions which have an important bearing on the validity of geochemical methods of prospecting for oil and gasfields. A number of factors have been found to be highly disturbing, namely: earth topography, ground-water percolation and seepage, barometric pressure variations, etc. These effects result in fluctuations of the rate of escape of hyrdocarbons accompanied by horizontal shifts of leakage which give rise to the creation of artificial leakage highs altogether meaningless from the point of view of oil and gas accumulation at depth. Certain qualitative rules are given for correcting for such disturbing factors. E. I. R.

982. The Airborne Magnetometer. G. Muffly. *Geophys.*, 1946, **11**, 321.—This paper discusses the problem of magnetic exploration for oil from an aircraft. A new type of saturation magnetometer is described. Various orientation and stabilization schemes and their application to submarine detection and geophysical prospecting are discussed. It is shown that total-field measurement is far superior to vertical-component measurement. The newest Gulf apparatus using an automatically-stabilized, continuously-recording, total-field magnetometer is described. E. I. R.

983. Application of Continuous Profiling to Refraction Shooting. A. J. Barthelmes. *Geophys.*, 1946, **11**, 24.—The continuous profiling technique that is in general use for detailed structural investigations by the reflection method is applied to refraction shooting. This results in an increase in the resolving power of the refraction method.

The theory, assumptions, resolving power, shooting procedures, cost, and speed of surveying by this method are given. Sample records and cross sections are given to illustrate the method of routine analysis. E. I. R.

984. Correlation Refraction Method of Seismic Surveying. J. A. Gillin and E. D. Alcock. *Geophys.*, 1946, **11**, 43.—This paper gives details of a form of correlation refraction shooting which was successful in obtaining satisfactory results on the Edwards Plateau, W. Texas, where the reflection method had been unsuccessful. The method is illustrated by the results of an experimental survey. E. I. R.

985. Airplane Noise Interference With Seismic Prospecting. J. M. Kendall. *Geophys.*, 1946, **11**, 82.—The low-frequency sound produced by airplanes is briefly investigated, and its propagation through the atmosphere is considered. Data on a cargo-type airplane are presented. Rough calculations to determine the response of geophones to this sound field indicate that one airplane can blanket an area of several hundred square miles. Measures suggested for minimizing the interference are discussed. E. I. R.

986. Studies on Seismic Waves. I. Reflection and Refraction of Plane Waves. C. Y. Fu. *Geophys.*, 1946, **11**, 1.—By taking the apparent velocity along the boundary as the parameter instead of the angle of incidence, the equations for the different wave amplitudes may be put in more symmetrical forms. In this way, it is more convenient to discuss both the body waves and the Raleigh waves at the same time. A difficulty in the plotting of the square root of the wave intensity against the angles is also discussed. When the reflection or refraction coefficient is not real, the meaning of the intensity, as obtained by squaring the absolute value of the latter quantity, needs clarification. E. I. R.

987. Studies on Seismic Waves. II. Raleigh Waves in a Superficial Layer. C. Y. Fu. *Geophys.*, 1946, **11**, 10.—Lamb's method in the theory of the plate is extended to the case in which one of the surfaces is not free. The resulting determinantal relation is similar to that of Sezawa. It is then simplified and special cases of the frequency–velocity relation are discussed. Even when the thickness of the layer is as small as a wavelength, the interaction of the upper and lower boundaries of the layer is quite slight and Raleigh waves and Stoneley's waves may be discussed separately. A few points in connexion with the application of this frequency relation to the ground-roll problem are also discussed. E. I. R.

988. Studies on Seismic Waves. III. Propagation of Elastic Waves in the Neighbourhood of a Free Boundary. C. Y. Fu. *Geophys.*, 1947, **12**, 57.—Continuous and spherical harmonic waves are generated at an internal point of the medium. It is shown that near a free surface in addition to the ordinary types of body and surface waves, there are also inhomogeneous waves and surface waves which are not of the Raleigh type. E. I. R.

989. Informal Discussion of Explosives Hazards on Seismograph Crews. G. M. Kintz. *Geophys.*, 1946, **11**, 148.—This paper clearly shows the need for a standard set of instructions in the safe handling and use of explosives in the geophysical industry. It suggests the appointment of an agency, such as the Bureau of Mines, to collect data regarding accidents and near-accidents in which explosives were involved. The agency would analyse this data and compile a standard set of instructions that should prevent most of the explosives accidents occurring at present. Several accidents which occurred while explosives were being used by the geophysical industry and which were reported to the Bureau of Mines during the last 3 years are discussed and analysed. E. I. R.

990. Effect of Surface Topography on Seismic Mapping. M. B. Widess. *Geophys.*, 1946, **11**, 362.—The presence of rough-surface topography in a prospect frequently constitutes a source of error in seismic mapping and poses the question of what computational methods can be applied by which seismic maps may be freed of the effect of surface relief. Various aspects of the problem are described. The use of a plane datum–horizon is generally adequate as a solution of the problem. For greater refinement, the structural map may be modified to account for the overburden effect, the approximate magnitude of which is considered. Further modification may be required when lateral variations in subweathering velocity occur. Statistical analysis for determining the degree of conformity between surface topography and mapped structure at depth is useful in gathering data on the influence of surface topography. E. I. R.

991. Seismograph Evidence on Depth of Salt Column, Moss Bluff Dome, Texas. H. W. Hoylman. *Geophys.*, 1946, **11**, 128.—Clear reflections at times of approximately 2·3 and 4·4 sec were obtained consistently on a series of records shot directly over the shallow cap rock of the Moss Bluff dome. There are three possible interpretations:

The first arrival is a reflection from the base of the salt column at a depth of 16,000 ft. The later arrival is either a reflection from the basement complex at 26,000 ft or a multiple reflection from the base of the salt column.

The first arrival is a reflection from a discontinuity within the salt column and the later arrival is a reflection from the base of the salt column at 36,000 ft.

Reasons are given for preferring the multiple reflection interpretation.

E. I. R.

992. On Well Velocity Data and Their Application to Reflection Shooting. P. E. Narvarte. *Geophys.*, 1946, **11**, 66.—This paper gives a practical method of deriving a generalized time–depth relation from well data. The chief advantage of this method is that it does not neglect the stratigraphic effect on the velocity distribution. The routine method of calculation is illustrated by an actual field example. E. I. R.

993. Interpretation of Well Shot Data. Part 3. C. H. Dix. *Geophys.*, 1946, **11**, 457.—This paper outlines a simple method of taking into account any lateral variations in velocity. The problem arising when 3 wells are shot is discussed in some detail. It is shown that by tilting the linear distribution of velocity with depth in a certain way all the well-shooting results can be tied together and a single linear velocity–depth relation used for the whole area. A method is also given for determining the lateral change of velocity by shooting only 1 well, and an approximate method of determining the tilt of the datum plane is discussed. E. I. R.

994. Notes on Shot Point Procedure. F. J. Williams. *Geophys.*, 1946, **11**, 443.—Some characteristics of seismic explosives are considered in order to explain the reasons for the suggested shot-point procedure. By the routine use of such a standard procedure the efficiency, safety, and quality of the records are considerably increased. The author attaches particular importance to the preparation of the charges and the use of adequate firing currents. E. I. R.

995. An Observational Method to Overcome Zero Drift Error in Field Instruments. I. Roman. *Geophys.*, 1946, **11**, 466.—By using a four-step oscillating method of observation, four values are obtained for the increment in the measured value between consecutive stations. If the drift or "zero creep" of the instrument is regular, even when large, or not linear, this furnishes a means of improving the reliability of the readings and permits the detection of erratic readings. It is suggested that this method should be used for laying out the network of base stations. An example shows the application of the method to a gravimeter survey. E. I. R.

996. Patent on Geophysics. H. Hoover, Jr., assr by mesne assignments to United Geophysical Co. U.S.P. 2,417,077, 11.3.47. Seismometer—a portable electromagnetic seismometer responsive to transverse vibrations. R. B. S.

997. Geophysical History of the La Gloria Field, Jim Wells and Brooks Counties, Texas. W. C. Woolley. *Geophys.*, 1946, **11**, 292.—This paper presents a historical record of

the geophysical activity in the La Gloria Field area. The discovery well was drilled and completed in 1938–39. The results of the following surveys can be compared with the structural contour map prepared from the drilling records: torsion balance 1934–35, correlation reflection seismograph 1936, dip reflection seismograph 1938, correlation reflection seismograph 1938, and gravity meter 1943–44. E. I. R.

Drilling.

998. Drilling the World's Deepest Well. N. Williams. *Oil Gas J.*, 29.3.47, **45** (47), 160; K. M. Fagin. *Petrol Engr*, Mar. 1947, **18** (6), 55.—An account is given of the drilling operations and the problems encountered in drilling the Superior Oil Company's 51-11 Weller well in Caddo County, Oklahoma. Drilling was commenced in April 1946 and by March 1947 the well had reached a depth of 17,236 ft. R. B. S.

999. Modern Rotary Drilling. Parts 1–10. J. Zaba. *Oil Gas J.*, 4.1.47, **45** (35), 75; 11.1.47, **45** (36), 87; 18.1.47, **45** (37), 83; 25.1.47, **45** (38), 287; 1.2.47, **45** (39), 69; 8.2.47, **45** (40) 97; 15.2.47, **45** (41), 107; 22.2.47, **45** (42), 175; 1.3.47, **45** (43), 91; 8.3.47, **45** (44), 95.—These are the first ten of a series of brief articles on modern drilling practice. The sub-titles are: (1) Introduction; (2) Basic Considerations; (3) Rigging Up; (4) Moving In; (5) Location Layout; (6) In-line Layout for Steam Rig; (7) Location Layout for Power Rig; (8) Drilling Derricks; (9) API Substructures; and (10) Non-API Substructures. R. B. S.

1000. Possibilities and Problems of Drilling Beyond the Continental Shelves. H. E. Gross. *Petrol. Tech.*, Nov. 1946, **9** (6) (*A.I.M.M.E. Tech. Pubn.* 2095), 1–7; *Petrol. Engr*, Oct. 1946, **18** (1), 186.—For drilling in water deeper than 500–600 ft rigid foundations would be too costly, and therefore floating foundations would be used. The derrick floor and drilling platform would have to be at a constant level, and fixed in position. The casing and conductor pipe would have to be in constant tension. Ample storage space would be essential. An open sub-structure supported on sealed hulls suitably anchored is proposed. The drilling platform is placed 40–50 ft above sea level so as to be above storm waves. Water could be admitted to or pumped from the hulls to keep the drilling platform at a constant level. Arrangements would be provided for keeping the two hulls on an even keel. Hydraulic rotary tables would keep strings of pipe under constant tension. Tension on the anchor cables would be reduced by controlled propellors attached to the hulls, and these propellors would counteract rotary-table torque. The hulls would afford storage for mud, oil, and water.

1000 h.p. might be needed for stabilizing the structure in big ocean storm waves. Instead of cables for anchoring, buoyant drill-pipe cemented into the sea floor might be used. G. D. H.

1001. Hard Rock Drilling. D. Johnston. *Oil Gas J.*, 5.4.47, **45** (48), 62. (*Abridged version of paper presented before Southwestern District Div. of Production, A.P.I., Fort Worth*, March 1947.)—The geology and drilling problems encountered in the Permian Basin area of W. Texas and New Mexico are outlined and an analysis is presented of the drilling costs and the effect of (1) weight on bit, and (2) mud characteristics, on the drilling rate in the hard formations encountered in this area. Possible future improvements in drilling practices and equipment resulting in reductions in drilling time are also reviewed. Three references are appended. R. B. S.

1002. Deep-Water Drilling on Lake Maracaibo. P. Reed. *Oil Gas J.*, 18.1.47, **45** (37), 36.—The methods described have been designed and developed to drill oil wells anywhere in Lake Maracaibo where the deepest point is from 80 to 90 ft. Barges and caissons are used. Unusual features are employed—*e.g.* all-welded derricks are used with the main drawworks welded to the sub-structure. Caissons have grouted joints and are cast of concrete around cylindrical inner shells fabricated from checkered plate with the rough side out. Reinforcing is provided in 3¼-in spiral steel rods. Caissons are moved about the yard by a Whiting 50-ton travelling gantry crane, supplemented by a 15-ton auxiliary hoist. The 80-ton caissons are not driven into the lake bed, but are dead weighted to bearing by a total weight of 200 tons, which is considered sufficient to ensure a desirable factor of safety for handling pulling loads during drilling opera-

tions. Caissons penetrate the lake bottom 60 to 100 ft. Maximum rise of the tide in the lake is only 1 ft. Caissons are fabricated in 15-ft sections, which are later assembled for the length required, the longest being 180 ft. More than 1200 wells have been drilled in this lake. A. H. N.

1003. Refitted Boiler Barge Contains Unique Design Features. E. H. Short. *Oil Gas J.*, 8.3.47, **45** (44), 71.—A refitted boiler barge suitable for supplying power for marine drilling operations is described. R. B. S.

1004. Wells Drilled With Horizontal Drain Holes. Anon. *Petrol. Engr*, Feb. 1947, **18** (5), 174.—An account is given of the methods used in drilling horizontal drain holes from a vertical bore by means of flexible drill pipe and a turbine-actuated drilling bit. R. B. S.

1005. Air-Operated Brakes Successfully Used in Gulf Coast Drilling. E. H. Short, Jr. *Oil Gas J.*, 15.2.47, **45** (41), 78.—To reduce crew fatigue, power-operated brakes were introduced and successfully operated in the rig described. Hydraulically controlled, feed-off is accomplished by throttling fluid movement in a simple closed hydraulic system. The conventional hand-brake is modified to leave the handle in its retracted position, but always operable for emergency or auxiliary application. The hydraulic system will permit steady, even feed-off rates of 0 to 65 ft per hr with 10 lines on the blocks. For higher rates of feed-off band slippage is sufficient and a graduating valve is provided to adjust air pressure to band cylinders to the desired rate. The hydraulic system is not used during this high rate of penetration. The air-operated brakes are composed of seven major component units: The main control cabinet; the band assembly, driller's side; the band assembly, opposite side; the air-control manifold; the hydraulic assembly; the manual brake linkage, and the air supply. The seven components are described, and illustrated diagrammatically and photographically and their method of use fully discussed. A. H. N.

1006. New Diesel-Electric Barge Rig Designed for Routine Drilling to 15,000 ft. Anon. *Oil Gas J.*, 11.1.47, **45** (36), 59–60.—The rig consists of a power barge and a drilling barge. These are briefly described. Three 700-h.p. 900 r.p.m. super-charged diesel engines, each directly connected to a 375-kw generator with a 60-kw constant-voltage generator mounted on top and driven by V-belts from the main generator shaft, furnish power for the rig. The 60-kw generators are equipped with Thyrite-controlled exciters so that the voltage generated remains constant though the engine speed may vary. Each engine is provided with a closed cooling system consisting of a tube-type heat exchanger and a motor-driven raw-water pump. The jacket water is circulated through the engine and heat exchanger by a pump built on the engine. The raw water is also pumped through a small heat exchanger for cooling the lubricating oil. Of particular interest, in connection with the power plant, is the use of electro-hydraulic governors which automatically adjust the engine speed as the load demand varies. The speed of the engines therefore may vary from 450 to 900 r.p.m., depending upon the load demand. Since the electro-hydraulic governors permit use of the lowest possible engine speed under any given load demand, engine wear, and fuel consumption are held to a minimum. Details of the speed control are given. During hoisting all three generators are employed. The derrick, mud-pumps, blow-out preventers, and other equipment are briefly described. A. H. N.

1007. Controlled Directional Drilling of Wells. Part I. G. L. Kothny. *Producer's Monthly*, Feb. 1947, **11** (4), 28. (*Paper presented at National Conference on Petroleum Mechanical Engineering, A.S.M.E., Tulsa, Okla.*, Oct. 1946.)—See Abstract No. 794 (1947).

1008. Controlled Directional Drilling of Oil Wells. Part II. G. L. Kothny. *Producer's Monthly*, Mar. 1947, **11** (5), 27. (*Paper presented at National Conference on Petroleum Mechanical Engineering, A.S.M.E., Tulsa Okla.*, Oct. 1946.)—See Abstract No. 789 (1947).

1009. Drillable Bridging Plug as Shooting Tamp. J. D. Dunigan and C. B. Snodgrass. *Oil Wkly*, 3.3.47, **125** (1), 39.—A brief description is given of a drillable bridging which has been used to set above nitroglycerin shots in open hole and in perforated or unperforated pipe sections. The casing above the shot-hole is kept in place by the plug.
R. B. S.

1010. Larger Drill-Pipe Results in Greater Speed in Drilling Gulf Coast Wells. E. H. Short, Jr. *Oil Gas J.*, 22.2.47, **45** (42), 147.—The larger pipes give greater circulation rates for the drilling fluid which is particularly necessary in the deeper wells drilling nowadays. Graphs illustrate the characteristics obtained with the 5-in o.d. as compared with 4½-in o.d. drill-pipes. Greater penetration rates have been recorded through the increased circulation possible with larger pipe and it is expected that stuck drill-pipe with be greatly reduced. The 5-in drill-pipe offers 33% more torsional strength than the 4½-in and it is also expected that part of the wear usually absorbed by tool joints will be distributed over the drill-pipe. One of the questions raised during the preliminary investigation of the 5-in was with regard to the possibility of excessive pressure drop in the annular space between the 5-in o.d. drill-pipe and the 9⅝-in casing. Engineering observations on a Humble well drilling in Galveston Bay with 5-in drill-pipe showed that at no time during drilling were there indications of lost returns in addition to those normally observed while drilling with 4½-in drill-pipe. Other data show no more trouble with gas-cutting with the larger than with the smaller pipe.
A. H. N.

1011. Rotation of Casing During Cementing. R. E. Edwards. *Oil Wkly*, 17.2.47, **123** (12), 24–26.—Laboratory and large-scale experiments are described in which the benefits of rotating the casing while cementing appear to be that they give better distribution of the cement around the casing.
A. H. N.

1012. Interchangeable Dual Pump Mounting. E. Sterrett. *Oil Wkly*, 3.3.47, **125** (1), 41.—Interchangeable mountings for compounding mud pumps with a minimum of trouble are briefly described.
R. B. S.

1013. Patents on Drilling. C. B. Aiken, assr to Schlumberger Well Surveying Corpn. U.S.P. 2,411,843, 3.12.46. Compensating Means for Electrical Borehole Apparatus.—An electrical well-logging apparatus which automatically compensates for temperature variations.

D. Silverman, assr to Stanolind Oil and Gas Co. U.S.P. 2,412,363, 10.12.46. Well Logging.—An apparatus for detecting the location and character of produced well fluids.

A. Frosch, assr to Standard Oil Development Co. U.S.P. 2,412,575, 17.12.46. Well logging.—An apparatus for simultaneously measuring two physical properties of formations traversed by a borehole (presumably porosity and permeability).

F. S. Crane. U.S.P. 2,412,875, 17.12.46. Pipe-Screwing Device.—A combined pipe elevating and screwing collar.

B. W. Sewell, assr to Standard Oil Development Co. U.S.P. 2,412,915, 17.12.46. Pressure Core Barrel.—A pressure retaining coring assembly for bringing a core to the surface at formation pressure: consists of a core barrel which can be lowered into and raised completely out of a string of drill-pipe during normal drilling operations, and having an automatic valve which closes when the core barrel is lifted out of the coring position.

J. S. Morgan and D. A. Murphy, assrs to the National Superior Co. U.S.P. Reissue Re 22,825, 24.12.46. Swivel.—A swivel for rotary drilling.

E. F. Aston. U.S.P. 2,412,939, 24.12.46.—Core drill.

H. B. Deckert. U.S.P. 2,413,297, 31.12.46. Pipe Holder.—A drill-pipe racking device for use in derricks.

L. A. Courter, assr to the Dow Chemical Co. U.S.P. 2,413,435, 31.12.46. Method of Determining Permeability of Earth Formations Penetrated by Well Bores.—A method of permeability determination by introducing into the well two liquids of vary-

ing density so that the fluid interface is originally located above the formation to be tested, and then measuring the rate of fall of this interface under a known applied pressure by means of a logging instrument which is also patented.

W. C. Scrivener and A. G. Brewer. U.S.P. 2,413,658, 31.12.46. Base Construction for a Mast and Derrick.—A pivoting union for anchoring a mast or portable derrick.

E. G. Gartin, assr to Joy Manufacturing Co. U.S.P. 2,415,204, 4.2.47. Adjustable Support.—A triple clamping device.

C. W. Savitz, assr to Halliburton Oil Well Cementing Co. U.S.P. 2,415,221, 4.2.47. Well Surveying Instrument.—A device for surveying a well to determine the extent and direction of its deviation from the vertical.

G. L. Kothny, assr to Sperry Sun Well Surveying Co. U.S.P. 2,415,249, 4.2.47. Well-Surveying Instrument.—An instrument for making a continuous record of bore-hole inclination.

W. D. Mounce, assr to Standard Oil Development Co. U.S.P. 2,415,364, 4.2.47. Logging Bore Holes.—An alternating current method of electrical well logging.

J. J. Santiago, assr to Grant Oil Tool Co. U.S.P. 2,415,608, 11.2.47. Hydrostatic Bailer for Wells.—An automatically controlled hydrostatic well bailer.

E. A. Johnson, assr to Standard Oil Company. U.S.P. 2,415,636, 11.2.47. Method and Apparatus for Logging Wells.—An electrical method of continuously logging bore-hole diameter.

W. B. Costin. U.S.P. 2,416,613, 25.2.47. Fishing Tool for Deep Wells.

S. Krasnow, assr to Geophysical Development Corpn. U.S.P. 2,416,702, 4.3.47. Apparatus and Method for Measuring Bore-Hole Radioactivity.

C. M. O'Leary, assr to H. C. Otis. U.S.P. 2,416,842, 4.3.47. Well Cementing Apparatus.—An apparatus for selective cementing.

G. E. Cannon, assr to Standard Oil Development Co. U.S.P. 2,417,235, 11.4.47. Drilling Fluid.—A method of reducing water loss by filtration by suspending a water-soluble starch ester of a low molecular weight aliphatic acid in the drilling fluid.

R. B. S.

Production.

1014. Classification of Oil Discoveries and Fields. Anon. *Petrol. Engr*, Jan. 1947, **18** (4), 124.—The following terms are defined: pool, area, field, group, district, region, zone, sand, interval, formation, reservoir, and fault block or block. These definitions are discussed and examples are given of each. It is suggested that this system of classification should be strictly adhered to, in order to avoid confusion which arises when these terms are inappropriately used. R. B. S.

1015. New Well-Completion Technique. T. S. West. *Petrol. Tech.*, Sept. 1946, **9** (5) (*A.I.M.M.E. Tech. Pubn. No.* 2094), 1–17.—Only four ways can be postulated whereby a high gas–oil or water–oil ratio can initially arise in a well when the zone exposed for production is entirely within the oil column. These are as follows:—

(*a*) Failure of the cementing material;
(*b*) Vertical coning;
(*c*) Failure along the boundary between the cement and the wall of the well;
(*d*) Failure of the formation forming the wall of the well. Cement failures are probably almost always due to contamination with mud. The frequent occurrence of thin impermeable streaks in sand sections suggests that vertical coning may be less common than is generally assumed. It is unlikely that the mud filter-cake is completely removed from the well walls before cementing, and its presence between the wall and the cement is a possible source of failure if it should flow out under the applied pressure differential. Formation erosion is a further possible mechanism of failure.

The histories of 3 wells in the Oakville area of Live Oak County, Texas, suggest that the failures were due to movement of solid material, and that coning was not the cause

of the high water–oil ratios. An open-hole gravel-pack type of completion procedure has been devised to prevent failures of this kind by preventing movement of all solid material in the space in which completion is made. Gravel is dumped around a slotted liner which extends above the bottom of the casing, and when sufficient gravel is in place a mixture of quick-setting cement and sand is placed on top as an impermeable plug. With this arrangement any flow of drilling mud or sand tends to be self-annihilating. Experiment has shown the effectiveness of plugs of this type. The average time of making the installation is about 6 hr if the cement sets in 2 hr.

It was found that the gravel size for approximating complete prevention of sand production had an average particle size about six times the sand grain size at the 10% point on a sieve analysis curve. Experiment has indicated that completely filling the space to be gravel-packed, thereby preventing the liberation of silt as a result of disintegration of the oil sand will permit the use of gravel sufficiently small to provide complete screening action without danger of plugging, regardless of the character of the sand. The use of even a very small gravel leads to a relatively small decrease in the rate of production under the usual conditions of application. G. D. H.

1016. Purpose of Acidizing Sand Formations. E. N. Jones. *Oil Gas J.*, 22.3.47, **45** (46), 295 (*Engineering Fundamentals No.* 278).—The purpose of acidizing, and the data needed in planning acidizing operations are discussed. A simple method of estimating the amount of acid needed is briefly described. R. B. S.

1017. Plotting Back-Pressure Open Flow Curves. W. F. Martin. *Petrol. Engr*, Mar. 1947, **18** (6), 78.—The author has devised a chart for computing the open flow of gas wells from back-pressure tests which reduces calculation to a minimum. This chart is explained and its use is illustrated by several examples. R. B. S.

1018. Calculations of Bottom-Hole Pressure. F. C. Fowler. *Petrol. Engr*, Mar. 1947, **18** (6), 88.—An equation is derived which permits the direct calculation of bottom-hole pressures in gas wells. The necessary data consist of well-head pressure, well depth, temperature gradient of well, and gas composition or gravity (either of which can be used to determine pseudo-critical temperature and pressure). The use of this equation is illustrated by an example : its accuracy is comparable to that of the trial and error methods proposed by other investigators, and in addition the calculations are less laborious. Six references are appended. R. B. S.

1019. Core Analysis—Practical Application to Oil and Gas Reservoirs. J. H. Campbell. *Petrol. Engr*, Dec. 1946, **18** (3), 100.—The fundamental principles of core analysis and reservoir behaviour are briefly discussed. R. B. S.

1020. Central Treating Plant Performs Dual Function. N. Williams. *Oil Gas J.*, 1.3.47, **45** (43), 56.—A description is given of a treating plant which is used not only for oil–water separation, but also for the treatment of separated water for water injection purposes. The treating plant, the method of water separation, and the settling, chemical treatment, and filtration of the water are each described. R. B. S.

1021. Heating and Cleaning Santa Maria Heavy Crude. R. L. Lauenstein. *Petrol. Engr*, Mar. 1947, **18** (6), 67.—The gravity of crudes produced in the southeast portion of the Santa Maria Valley field ranges from 7° to 14° API and the viscosity of the heaviest may be as high as 2,000,000 sec—23 days—(Saybolt Universal). These crudes have to be heated to about 130° F in order to enable sand and water to separate out : this heating also enables most of the natural gas to break free and thus prevent foaming in the gas–oil separators. A typical flow-line heater for this purpose is described. R. B. S.

1022. Gun Perforation Design for Uniform Productivity. W. J. Jackson. *Petrol. Engr*, Mar. 1947, **18** (6), 113.—The effect of gun perforations on well productivities are discussed and experimentally determined curves are presented relating relative productivity to the number of perforations per foot for ½-in and ¼-in perforations in 6-in and 12-in casing : the relative productivity is defined as the ratio of the productive capacity of the cased and perforated well to that of an uncased well of the same

diameter. The relative productivity increases with the number of perforations per ft and with the size of the perforations, but decreases with increasing casing diameter. The use of this chart to determine the best number of perforations per ft for any well is described. Six references are appended. R. B. S.

1023. Increasing Dually Completed Gas Well Production. P. L. Shelton and J. M. Clark. *Oil Wkly*, 3.3.47, **125** (1), 31.—The results of tests on dually completed gas wells characterized by unstable flow conditions are described. These results show that the problem of increasing daily production in such deficient wells in a dual completion can be resolved into one of decreasing the effective flow area, and thus increasing the velocity of the flowing gas.

A method was devised which decreased the effective flow area of the upper section and also reduced the area through which the lower section was to produce, thus ensuring a high flowing velocity from both sections. This method consisted of snubbing a macaroni inside the tubing under pressure with special equipment. The lower section was then produced through the macaroni string and the upper section through the annular space between the macaroni string and the tubing.

Special tools and well-head equipment had to be designed which could be adapted to the existing Christmas-tree and tubing string for this type of completion. These are described. R. B. S.

1024. Carthage Engineers Fight Hydrates. G. Weber. *Oil Gas J.*, 5.4.47, **45** (48), 58.—The conditions in the gas-gathering system in use in the Carthage field are such as to cause serious hydrate plugging at ordinary winter temperatures. The method which has been employed in this field to prevent these troubles consists mainly of the installation of heaters: these installations are described. R. B. S.

1025. Effect of Crude Gravity on the Performance of Gas Drive Reservoirs. M. Muskat and M. O. Taylor. *Petrol. Engr*, Dec. 1946, **18** (3), 88.—Calculations of ultimate recovery, free-gas saturations and maximum gas–oil ratios as functions of crude gravity are presented. Reservoir pressure, gas–oil ratio, and productivity index were also calculated as functions of cumulative recovery for five crudes of 10°, 20°, 30°, 40°, and 50° API gravity. The effects of gas solubility, oil viscosity, and oil shrinkage were all taken into account in the calculations. These properties of the oil and gas as functions of crude gravity and the permeability–saturation relations were taken from the experimental results of previous investigators. In all cases the same permeability–saturation curve was used with an assumed equilibrium gas saturation of 10% and with a connate water saturation of 25%.

The results of these calculations showed that the ultimate free-gas saturation developed during pressure depletion increases uniformly with API gravity of the crude. The ultimate recovery, as a fraction of the initial oil content also increases with the API gravity, although the curve flattens at higher gravities. The absolute recovery, expressed as a fraction of the pore space, shows a maximum at about 40° API gravity. The maximum gas–oil ratio developed during pressure depletion is greatest for the 10° API gravity crude, falls to a minimum at about 22° API gravity, and then rises uniformly with increasing crude gravity. The productivity index at depletion, expressed as a fraction of its initial value, decreases with increasing crude gravity.

Six references are given. R. B. S.

1026. Liner Job Well Remedial Work in East Texas Field. D. W. Akins. *Petrol. Engr*, Jan. 1947, **18** (4), 96. (*Paper presented before A.P.I.*)—See Abstract No. 801 (1947).

1027. Composition of Mud Acid and its Function in Sand Horizons. E. N. Jones. *Oil Gas J.*, 5.4.47, **45** (48), 107 (*Engineering Fundamental No.* 280).—Regular mud acids consist of a mixture of: (1) fluorine which attacks and dissolves the mud and sand; (2) hydrochloric acid to maintain a low pH after the fluorine has reacted; (3) detergents which improve the acid penetration by removing grease; (4) emulsion breakers to prevent emulsion formation; and (5) alcohols to reduce the surface tension and hence increase the penetration. The functions of mud acids are (1) to increase the well-drainage area; (2) to clean liners or perforations and open void spaces;

(3) to increase the life of flowing or pumping wells; and (4) to clean the sand face and prepare the formation for squeeze cementing jobs. R. B. S.

1028. Setting Multiple Packers. Anon. *Producer's Monthly*, Mar. 1947, **11** (5), 11.—A method of setting multiple packers is briefly described and illustrated by a diagram. R. B. S.

1029. Mud Changes Formation Permeability and Productivity. E. N. Jones. *Oil Gas J.*, 29.3.47, **45** (47), 179 (*Engineering Fundamentals No.* 279).—The deleterious effects of drilling mud on the permeability and productivity of producing formations are discussed and a method of mud removal by acid treatment is briefly described. R. B. S.

1030. New Method to Determine Permeability. J. C. Calhoun, Jr. *Petrol. Engr*, Feb. 1947, **18** (5), 103.—An equation is derived for determining the permeability of porous media to gases from a knowledge of: (1) the initial and final pressure differentials through the porous medium, (2) the area of the porous media perpendicular to the line of flow, (3) the length of the porous medium, (4) the volume and viscosity of the gas, and (5) the time of flow: it is assumed that the gas is incompressible and that steady state conditions prevail. A laboratory apparatus and procedure designed to measure permeability using this equation is described. The results of these experiments show that the permeability to gases as measured by this method vary according to the nature of the gas, as has been found by other methods. These results also confirm the fact that the permeability to all gases tends to the same value at infinite pressure, this limiting value being equivalent to the permeability to liquids. R. B. S.

1031. Selective Plugging by Smokes. R. F. Nielsen. *Producer's Monthly*, Feb. 1947, **11** (4), 16.—See Abstract No. 224 (1947).

1032. Evaluation of Pressure Maintenance by Internal Gas Injection in Volumetrically Controlled Reservoirs. E. C. Patton. *Petrol. Tech.*, Nov. 1946, **9** (6) (*A.I.M.M.E. Tech. Pubn. No.* 2098), 1–41.—A comprehensive study has been made of a proposed method of using the basic physical data for tight volumetric-type reservoirs and their fluids in order to assess the practicability of undertaking gas injection, and to estimate the profit which may be expected from such an operation. A method is described for correlating laboratory permeability data with field performance history, and using these to predict future performance from past performance. This involves the substitution into the material-balance equation of a factor intended partially to take into account deviations from ideal behaviour resulting from non-homogeneity of the reservoir rock. The theoretically most nearly correct method of applying flash and differential laboratory data in their appropriate places in the material-balance equations is described.

Equations are presented for converting material-balance predictions directly to a time basis, together with methods of predicting the time at which the field economic limit will be reached and of estimating the relative number of pumping wells at any time under pressure maintenance as compared with primary performance. The various equations and methods may be used to predict the relationship between gas-production rate and time in order to establish a basis for the design of suitable gasoline or compressor plants to cater for the entire fields, as well as to estimate the economically most favourable time for beginning gas injection.

The sale of residue gas obtained in the operation of a reservoir by natural depletion in certain circumstances may be more profitable than pressure maintenance by gas injection with the expected resultant increase in ultimate oil recovery. In this connexion the relationship between the price of gas and the price of oil, and the magnitude of the saving due to deferring of the date of commencing pumping are important.

Although it is practically impossible to make an absolutely accurate forecast of the future under any given scheme of operation, the discussion provides a means whereby a reliable prediction may be made of the relative benefits of a gas-injection pressure

maintenance programme as compared with normal depletion for a volumetric-type reservoir. G. D. H.

1033. Benton Unit Approaches the Ideal Pressure-Maintenance Project. G. Weber. *Oil Gas J.*, 11.1.47, **45** (36), 56.—The field is of the high pressure gas-condensate type and plans for recycling were made from the start of the development of the field. Unitization under a model agreement was completed when the field comprised but 3 wells. Under its provisions the unit is being drilled with a minimum number of wells which will serve the dual purpose of providing sub-surface data for fixing the unit area and equities in it, and serving as producing and input wells for the pressure-maintenance programme. Production has been almost completely shut in, awaiting completion of the cycling plant now building. The pressure-maintenance programme involves injection of water as a make-up for shrinkage of processed gas. As a result of these far-sighted provisions, the Benton field, on the basis of reserves in place, should provide a new record for recovery at a development cost unmatched in the cycling industry. No evidence of water exists in either reservoir, since pressures declined even with limited withdrawals. At the original reservoir pressure of 3745 p.s.i. at 8000 ft in the " D " sand, " liquid " recovery is calculated from the laboratory tests on recombined samples to equal 71·5 brl/million cu. ft. With pressure mantenance it is estimated that 91% of liquids in place in the reservoirs may be recovered, whereas the pressure-depletion method of production would net only 57% of liquid reserves. The added recovery expected through unitized cycling operations amounts to more than 5,000,000 brl of liquid products valued in excess of $6,000,000.

The history of the field and the methods adopted for equity are described.

A. H. N.

1034. Pressure Maintenance at Richard King Designed to Handle Approximately 3,000,000 cu. ft. of Gas Daily. N. Williams. *Oil Gas J.*, 15.2.47, **45** (41), 76.—The history and development of the Richard King field of South Texas are given. The field is under a dissolved gas drive and plans to increase the ultimate recovery called for large quantities of gas to be injected in the reservoir. These plans are briefly discussed. A. H. N.

1035. Computations of Plunger Travel. Part I. E. A. Stephenson. *Oil Gas J.*, 1.3.47, **45** (43), 93 (*Engineering Fundamentals No.* 275).—The Marsh–Coberly formula for calculating the stretch of sucker rods (and hence the plunger stroke) is discussed. The method is illustrated by examples and it is shown how to simplify the solution of problems by this method with the use of graphs.

One reference is appended. R. B. S.

1036. Computations of Plunger Travel. Part II. E. A. Stephenson. *Oil Gas J.*, 8.3.47, **45** (44), 97 (*Engineering Fundamentals No.* 276).—Rieniet's method of calculating plunger stroke is discussed and illustrated by an example. Two references are appended. R. B. S.

1037. Importance of Clay Studies in Water Flood Operations. Part I. R. V. Hughes. *Producer's Monthly*, Feb. 1947, **11** (4), 13.—Modern methods of X-ray diffraction analysis, thermal analysis, and electron microscope examination, have shown that clays are composed almost entirely of crystalline matter, even though most of the particles are so small as to be of colloidal dimensions. The most common clay minerals are kaolinites, montmorillonites, and illites : the characteristics of these minerals are briefly discussed.

The three related properties of clays which are of outstanding importance in secondary recovery operations, especially water flooding are : (1) base exchange, (2) absorption and retention of water, and (3) deflocculation and flocculation. Base exchange is that property of clays which enables an exchange of cations between the clay and a surrounding solution to take place without destroying the lattice structure of the clay. Water is retained by clays in three ways and is denoted as : (1) crystal water—an integral part of the clay crystal ; such water can only be removed by heating above 500° C ; (2) broken-bond water—water which becomes adsorbed at the broken edges of clay particles in order to satisfy ions in those positions which become unsaturated by

division of the particles; temperatures of over 300° C are often required to remove this water; and (3) planar water—water which is adsorbed between the planar surfaces of the clay crystals; it is this water which accounts for the extreme swelling characteristics of some clay minerals. Deflocculation is defined as the state of a dispersion of a solid in a liquid in which each solid particle remains geometrically independent and unassociated with adjacent particles: *e.g.* the clay in a colloidal suspension is in a deflocculated state. Flocculation is defined as the formation of clusters of particles separable by relatively weak mechanical forces or by changes of a chemical nature at the interface between the particles and the suspending phase.

Seventeen references are appended. R. B. S.

1038. Importance of Clay Studies in Water Flood Operations. Part II. R. V. Hughes. *Producer's Monthly*, Mar. 1947, **11** (5), 12.—The common clays may be classified as: (1) hydrogen clays, (2) calcium clays, and (3) sodium clays. Hydrogen clays are those which have undergone extensive leaching and dehydration. They possess acidic characteristics and are most often found as surface and near-surface exposures in poorly drained areas: these clays seldom cause serious trouble to the secondary recovery producer. Calcium clays are normal constituents of the better agricultural lands: these clays are flocculated by fresh waters and remain permeable to them indefinitely, but they are deflocculated by oilfield brines unless converted to true sodium clays: sodium clays, however, are more easily converted into calcium clays (by thoroughly leaching a sodium clay in a dilute solution of a calcium salt thereby causing a base exchange reaction) than vice versa. As calcium clays are flocculated in the presence of fresh water and are therefore granular and more permeable to fresh waters, the presence of calcium clays in sands under (fresh) water flood, either naturally or through base exchange reactions, may be advantageous if recognized early during the life of the flood. Sodium clays are believed to indicate deposition in or contact with salt waters: a base-exchange reaction will take place between a calcium clay and a sodium chloride solution forming a sodium clay. It may be assumed that all clays and shales associated with producing sands of marine origin are sodium clays. Thus many troubles will occur around the well bore and within the producing sand if unfavourable base exchange reactions are allowed to occur at any time. Sodium clays are deflocculated and thus swell in the presence of fresh waters, but tend to become flocculated and thus permeable in the presence of salt waters.

Seven references are appended. R. B. S.

1039. Oil Production by Water. Part 10. Injection Well and Water Requirements. P. J. Jones. *Oil Gas J.*, 11.1.47, **45** (36), 78.—When a reservoir is saturated with producing wells produced at capacity, a decline in reservoir pressure is accompanied by a decline in producing rate. So the burden of maintaining producing rates is placed on injection wells. However, differences between producing and injection wells as to interference factors, permeability, completion in pay, and fluid viscosities usually favour a higher operating reservoir pressure, more injection wells, and fewer producing wells. As a rule, the optimum reservoir pressure is the pressure which requires the least total number of wells. Differences in operating expenses as between pumping and injection wells may also favour a greater number of injection wells. The total volume of water handled depends primarily on how much oil is produced before water appears in production. The dry oil reserve is a measure of water injection requirement. The greater the distance between injection and producing wells, the higher the oil recovery before water appears in production. A. H. N.

1040. Oil Production by Water. Part 11. Migration of Oil. P. J. Jones. *Oil Gas J.*, 18.1.47, **45** (37), 64.—Due to migration the production of oil by water will differ for the different rows of wells producing. Formulæ are developed giving the production of the different rows and graphs illustrate the results. A. H. N.

1041. Oil Production by Water. Part 13. Location and Spacing of Wells for the R-I Reservoir. P. J. Jones. *Oil Gas J.*, 15.2.47, **45** (41), 81.—The producing capacity at MER for the R-1 reservoir is 14,200 brl/day. About 60 producing wells saturate the reservoir. The optimum spacing for producing wells is the least distance between wells commensurate with depth. The optimum location for 60, or less, wells is within

the 140-ft contour. The optimum location for injection wells is along the water contact. A procedure for estimating producing and injection well capacities is indicated. A. H. N.

1042. Oil Production by Water. Part 14. Two-Pay Intervals. P. J. Jones. *Oil Gas J.*, 22.2.47, **45** (42), 130.—The characteristics of a radial reservoir having two pay intervals and the per-interval capacity to produce oil at MER by edge water are indicated. Control of per-interval producing rates will be considered in the next article. A. H. N.

1043. Results of Water-Flooding Oil Sands in North and North-Central Texas. D. B. Taliaferro and R. K. Guthrie. *Producer's Monthly*, Mar. 1947, **11** (5), 15. (*Paper presented at Annual Meeting, North Texas Oil and Gas Association, Wichita Falls, Texas*, Mar. 1947.)—A brief description is presented of the results obtained in field investigations of eleven typical water flood projects in Texas. An effort has been made to select projects that have been in operation for several years so that an estimate of the ultimate recovery by water-flooding can be made by extrapolating the production decline curves to an estimated economic limit. Each project is illustrated by: (1) a map of the property, showing the location of all producing, input, and abandoned wells as of January 1st, 1947; and (2) a graph showing the production history, the monthly volume of water injected, and the average injection pressure: this graph also indicates the volume of oil which has been recovered by water flooding to date that would not have otherwise been recovered. R. B. S.

1044. Utilization of Old Wells. W. A. Heath. *Producer's Monthly*, Feb. 1947, **11** (4), 18. (*Paper presented at Annual Meeting, A.P.I., Chicago*, Nov. 1946.)—The utilization of old wells in water-flooding operations and in air and gas-injection projects is reviewed from a historical standpoint. The difficulties encountered in the use of old wells, and the reconditioning of them for these purposes are then discussed. The various reconditioning methods are: (1) use of clean-out tools, such as wall scrapers, etc.; (2) shooting with nitroglycerin or marble shots; (3) application of heat to remove paraffin by steaming, circulating hot air, chemical reaction or electrical heating; (4) use of paraffin solvents; and (5) use of hydrochloric and mud acids. Twenty-one references are appended. R. B. S..

1045. Performance of Bottom Water-Drive Reservoirs. M. Muskat. *Petrol. Tech.*, Sept. 1946, **9** (5) (*A.I.M.M.E. Tech. Pubn. No.* 2060), 1–31.—A theoretical study has been made of the behaviour of wells and reservoirs producing by bottom-water drive. Assumptions were made that the pressures remained above the bubble-point and that the permeability to viscosity ratio of the water in the flooded zone was the same as for the oil in the oil-saturated pay. The treatment was based on the homogeneous fluid potential theory, and the effect of the difference in density between the oil and water was neglected. The proper potential distributions were derived and the nature of the rise of the oil–water interface below the producing wells was calculated.

The primary clean-oil production phase was expressed as a function of the displacement efficiency, defined as the fraction of the pay flooded out by the rising water-table at the time of first water entry. The variation of this displacement efficiency was calculated as a function of the well-spacing, pay thickness, the ratio of the horizontal to the vertical permeability, and the well penetration. The important parameter, other than the well penetration, was found to be the ratio of the well separation to the pay thickness multiplied by the square root of the ratio of the vertical to horizontal permeability. The displacement efficiency was found to decrease continuously as this parameter increases and for values of the latter exceeding 3·5 the efficiency varied inversely as the square of the parameter. It also increased with decreasing well penetration. It was concluded that in order to explain the delay in entry of water in wells producing by bottom water drive for periods longer than a few days' normal production, with drawdowns large compared with the differential density head between the oil and water it is necessary to assume that the vertical permeability is a very small fraction of the horizontal permeability.

The production history after water had broken through also was analysed, on the assumption that the production mechanism and details of the flow distribution

continue to be the same as during the phase of clean-oil production. The water cut was found to increase at an accelerated rate as production proceeds. The water–oil ratio at a given cumulative oil recovery per well would increase with increasing well penetration and increasing well spacing.

In the range of practical well spacings and physical parameters defining the producing system, the increments in clean-oil production per additional well decreased with increasing well density, and because of the limited gains in total economic oil recovery as the well density was increased, the optimum value of the spacing would be determined largely by economic considerations. G. D. H.

1046. Recent Innovations in Lease Work Barges. E. H. Short. *Oil Gas J.*, 5.4.47, **45** (48), 61.—Marine operating barges especially equipped for paraffin removal from tubing strings and lead lines are briefly described. R. B. S.

1047. Patents on Production. F. J. Norton, assr to General Electric Co. U.S.P. 2,412,470, 10.12.46. Production of Water Repellent Materials.—A method of making a solid body water repellent by treating with a mixture consisting of from 2·8% to 99·2% by weight of trimethyl silicon chloride and of from 97·2% to 0·8% by weight of silicon tetrachloride.

E. Buddrus and S. C. Carney, assrs to Phillips Petroleum Co. U.S.P. 2,412,765, 17.12.46. Recovery of Hydrocarbons.—A method of producing oil from partially depleted fields by injecting into the formation condensible hydrocarbon vapours consisting essentially of propane and butane: these vapours condense in the formation and render the crude oil more favourable to production: the method of recovering the light hydrocarbon vapours from the produced crude is also patented.

R. E. Edwards, assr to Halliburton Oil Well Cementing Co. U.S.P. 2,412,876, 17.10.46. Wire Brush for Use in Oil Wells.—A wire brush suitable for cleaning well casing, etc.

C. E. Zobell, assr to The American Petroleum Institute. U.S.P. 2,413,278, 24.10.46. Bacteriological Process for Treatment of Fluid-Bearing Earth Formations.—A method of increasing or facilitating the recovery of oil from oil-bearing formations by subjecting the formation to the action of *Desulfovibrio halohydrocarbonoclasticus*.

F. E. Dana. U.S.P. 2,415,729, 11.2.47. Method of Cleaning Oil Wells.—A method of removing paraffin deposits from oil-well tubing.

S. T. Yuster, assr to The Bradford District Pennsylvania Oil Producer's Association. U.S.P. 2,416,077, 18.2.47. Well Torpedo.—A well-shooting torpedo in which the charge is contained in an annular space having an outside diameter substantially as great as that of the bore-hole to be shot.

G. A. Thompson and S. A. Cejka. U.S.P. 2,416,359, 25.2.47. Apparatus for Lifting Fluid.—A special type of gas-lift apparatus.

C. E. Trautman and H. A. Ambrose, assrs to Gulf Research and Development Co. U.S.P. 2,416,360, 25.2.47. Prevention of Foaming of Hydrocarbon Oils.—A process of suppressing foaming in hydrocarbon oils by producing in the oil a fine stable dispersion of a liquid organo-germanium oxide which is substantially insoluble in the oil and not in sufficient amount to produce deleterious effects.

J Grant and J. J. Santiago, assrs to Grant Oil Tool Co. U.S.P. 2,416,441, 25.2.47. Determination of Well-Pipe Perforations.—An instrument having a thin outer shell which can be lowered into a well opposite a perforated section and then expanded against the casing to form indentations corresponding to the perforations.

C. E. Trautman and H. A. Ambrose, assrs to Gulf Research and Development Co. U.S.P. 2,416,503, 25.2.47. Prevention of Foaming in Hydrocarbon Oils.—An active defoaming compound consisting of a dehydrated silicon oxide condensation product.

C. E. Trautman and H. A. Ambrose, assrs to Gulf Research and Development Co. U.S.P. 2,416,504, 25.2.47. Prevention of Foaming in Hydrocarbon Oils.—A process of suppressing foaming in hydrocarbon oils by adding to them a liquid organo-silicol condensation product in excess of that which dissolves in the oil so as to produce a dispersion therein.

D. B. Collins, assr to Shell Development Co. U.S.P. 2,417,152, 11.3.47. Oil-Well Screen.—A special type of oil-well screen having inwardly diverging slots.

J. Caldwell, assr to The James Morrison Brass Manufacturing Co. U.S.P. 2,417,181, 11.3.47. Oil-Well Pressure Control System.—A new design of well-head equipment for withstanding high pressures. R. B. S.

Oilfield Development.

1048. Carthage Approaching Full Gas Production. G. Weber. *Oil Gas J.*, 29.3.47, **45** (47), 137.—The development of the Carthage gas and condensate field discovered in 1936 in Panola County, Texas, is reviewed. The total gas production by the end of March 1947 exceeded 200 billion cu. ft. R. B. S.

1049. South Texas Giant. C. J. Deegan and N. Williams. *Oil Gas J.*, 9.11.46, **45** (27), 60–64.—It is possible that the separate pools from Agua Dulce to La Gloria may eventually become a big field, 50–55 ml long and 3–7 ml wide. It may then be second only to East Texas as an oil reserve, and second to the Amarillo-Hugoton area as a gas reserve. The estimates of potential reserves are 1250–1750 million brl of oil, 12–15 million million cu. ft. of gas and 300–400 million brl of distillate. Shallow gas and oil were discovered at Agua Dulce in 1928; the Stratton field followed in 1931, Seeligson in 1937, La Gloria in 1939, Tijerina and Canales in 1944, and Monte Negra and Borregas in 1945. Merging is not quite complete, and a few dry gaps may persist.

The cumulative production at the beginning of July 1946 was 55,000,000 brl. The present allowable is 85,000 brl/day. Production is from numerous lenticular sands extending through the Frio-Vicksburg section. At Seeligson the depth range is 4600–7000 ft. Some sands have gas, some oil and gas, some gas and distillate. Over 85 distinct reservoirs have been noted. A series of structures occur along the Vicksburg flexure. In parts of the area the average well encounters four separate gas zones and three or four oil zones.

Apart from gas and condensate wells there are over 1100 producers.

The trend of developments is described. Tables give the annual production from 1938 for the entire area, and give some data on the separate pools. Part of a cross-section and a stratum contour map are included. G. D. H.

1050. Canadian Developments—1946. F. K. Beach. *Petrol. Engr*, Oct. 1946, **18** (1), 67.—At Turner Valley more than a million million cu ft of gas have been wasted, but a third of this quantity has been marketed.

In a third test of the Jumpingpound structure gas has been found in the top of the Rundle and saltwater lower. In the Brazeau area a well has reached 11,689 ft, finding two slivers of Rundle with gas, condensate, and water in the upper one. Imperial Shell Stolberg also found two Rundle slivers in drilling to 13,747 ft. The lower sliver has salt water.

Gas flows have been found in Roxana 3 K below 5000 ft. A hole near Lundbreck has had numerous oil shows and is fishing at 9912 ft. Royalite De Winton, 12 ml east of Turner Valley, had a good oil show in the Brown sand of the Fernie (Jurassic). Oil shows have also been found in the basal Blairmore, 18 ml north of Calgary. An oil discovery has been made a few miles northeast of the Wainwright field. Imperial's Provost discovery of oil was in the top of the Lower Cretaceous. McColl Frontinac and Union jointly discovered a big gas flow in eastern Alberta just north of the Montana border.

Geological and geophysical work continued in Alberta.

A wildcat is being drilled 40 ml north of Halifax, Nova Scotia. Tests are being drilled on the Gaspe Peninsula. On the Galt anticline there has been a gas show. G. D. H.

1051. Canada has Intense Exploration Programme. R. Sneddon. *Petrol. Engr*, Oct. 1946, **18** (1), 145.—15% of Canada's oil needs are supplied by the output of Norman Wells and Turner Valley, the latter now yielding 20,000 brl/day. The oil deficiency, and the cost of obtaining supplies elsewhere make urgent the investigation of Canada's further oil resources. The Fischer–Tropsch process and successful exploitation of the

Athabaska tar sands would contribute to the supplies. The oil possibilities of Western Canada are far from fully tested. Indeed, it has been stated that of the 1600 wells drilled in this area to date less than a dozen have been deep enough to test all the possibilities of the sections. Hence scarcity of good results in terms of production is not entirely discouraging. Exploration in Eastern Canada has not been successful.

G. D. H.

1052. Mexico To-day—Exploration and Production. Anon. *Oil Gas J.*, 2.11.46, **45** (26), 42.—The Mexican oil industry is handicapped by a serious labour problem. Much equipment is in urgent need of replacement. Labour costs have nearly trebled since the expropriation. Antiquated transport constitutes a further handicap. Finance has been lacking for adequate prospecting. Only 23 wildcats have been drilled since 1938, two having found oil and two gas. 75% of the reserves are at Poza Rica. 17 geological crews and 11 geophysical crews (6 seismic, 4 gravity-meter, 1 electric) are in the field.

Poza Rica produces 68,076 brl/day, providing 54% of the Mexican output. In mid-1946 the cumulative production was 248,100,191 brl of oil and 258,249,000,000 cu. ft. of gas. Production is from the Tamabra (Cretaceous) which averages 296 ft in thickness, and has a porosity of 10%.

In the northeastern area (an extension of the Rio Grande basin) 23 wells have been completed, the cumulative production being 7615 brl of distillate and 33,229,000,000 cu. ft. of gas. Production in this Mission gasfield is from the Vicksburg (Oligocene) at depths of 5800 ft. The porosity is 20% and the initial reservoir pressure was 2760 p.s.i.

On the flanks of the complex El Plan salt dome Pemex discovered the Concepcion and Encanto sands which produce elsewhere in the area. G. D. H.

1053. Brazil's Latest Discovery Spurs Interest in Oil Development. Anon. *World Petrol.*, Nov. 1946, **17** (12), 58.—Drilling in Bahia during the past 5 years has revealed 4 oilfields with about 30 producing wells. Lobato was the first discovery. Aratu has an oil horizon and a gas horizon. Itaparico and Candeias are the other fields. The combined output has not exceeded 2000 brl/day. Recently a well in the Candeias field found 200 ft of pay, and in a 24-hr test gave 1800 brl/day. 16 other producers in this area range 25 to 100 brl/day and average 60 brl/day. A still more recent well has a potential of 1000 brl/day. The sand appears to be lenticular. G. D. H.

1054. Estimates of Russian Oil Resources. E. Adams. *Petrol. Engr*, Oct. 1946, **18** (1), 178.—It has been estimated by Perejda that the U.S.S.R. oil production in 1945 was about 149 million brl. The 1939 production was 217 million brl. In 1940 the Baku area supplied 70% of the Russian output, but the Baku production later declined by about half. Maikop and Grozny provided 16% of the 1940 total, and the former fell into German hands, while the latter was greatly damaged. Elsewhere the production rose from 31 million brl in 1940 to 45 million brl in 1945; the changes in this period for various areas were Ural–Volga, 14 to 21 million brl, Emba 5 to 7 million brl, and Sakhalin 3 to 6 million brl.

In 1937 available reserves in Russia were about 6000 million brl. All geologists agree that Russia may have more unproved reserves than any other country, and may have two or three times as much sedimentary rock of a petroliferous type as U.S.A.

Of proved reserves, U.S.A. controls about 60%, Great Britain 23%, and Russia about 11%, the Netherlands 5%, and France less than 2%.

Transport is one of Russia's main obstacles in developing proved reserves. Climate provides other difficulties. G. D. H.

Transport and Storage.

1055. Design of Long Distance Natural Gas Transmission Lines. R. G. Strong and T. H. Beals. *Oil Gas J.*, 19.4.47, **45** (50), 88.—Origin, terminus, market requirements, size of pipe, number and size of compressor stations, geography of country, character and corrosivity of soil must be taken into account when designing high-pressure transcontinental pipeline systems. New lines are solid welded. Special consideration has

to be given to river crossings, and isolation valves provided. The most economical combination of pipe and power has to be determined for which purpose tables are provided for 24, 26, 28, and 30-in pipe and 1250 h.p. horizontal compressors, based on formulas for line flow, horse-power, and Barlow's formula. G. A. C.

1056. Transport of Liquid Fuel by Pipeline. Anon. *Petroleum*, 1947, **10**, 64 (*Condensed translation by R. Hammond of "Transporte de combustibles por tuberia," published in "La Ingeneria,"* 1946, **50**, 537–539).—A plan for the co-ordination of all pipelines in the Argentine Republic is being considered by the Government. Within the general plan one new gas pipeline and four oil pipelines are considered essential. The projects are in the hands of Yacimentos Petroliferos Fiscales (Y.P.F.) and the National Gas Directorate who will jointly study to provide a comprehensive solution of the economic transport of liquid fuels. The projects will involve legislation, and after the law has been promulgated the pipelines will function as public carriers, subject to Government control regarding charges, etc.

The surface transport of liquid fuel in Argentina is carried out uneconomically. Although it occupies seventh place as a world producer of petroleum and has long distances to cover there are, at present, only 400 km of pipe-line in the country.

Considering individual Argentine petroleum deposits, that at Comodoro Rivadavia is extensive and this also possesses large reserves of natural gas. Much of this gas has been, in the past, discharged to the atmosphere, for lack of a pipeline to transport it economically.

There are important gas and petroleum deposits in Mendoza, the output from which has to be conveyed to coastal refineries and is at present transported by rail. Gas reserves at Plaza Huincul remain dormant for lack of transport by pipeline and petroleum from this source is transported to Buenos Aires by rail.

The relative costs of surface and pipe-line transport show the latter to be the more economical as proved by American statistics. Pipeline transport also has advantages as regards safety and regularity and there are also vital military advantages.

F. W. H. M.

1057. Approximate Performance of Centrifugal Pumps. W. L. Nelson. *Oil Gas J.*, 3.5.47, **45** (52), 107.—No. 142 in the *Refiner's Notebook* series gives curves which indicate the approximate head and power for single-stage centrifugal pumps of either single or double suction. Reference is also made to No. 136 in this series. An example is provided and worked out. G. A. C.

1058. Applying Plastic Coating to Oil Tanks. W. J. Davis. *Petrol. Engr*, Jan. 1947, **18** (4), 182.—The advantages of plastic coating over other methods of protection against corrosion for oil-tanks is discussed. The procedure generally adopted for preparing tanks and carrying out the plastic coating operation is then described.

R. B. S.

1059. Patents on Transport and Storage. F. Sutton, assr to Saunders Valve Co., Ltd. U.S.P. 2,412,105, 3.12.46. Fluid Controlling Valve.—A self-closing and self-locking diaphragm valve having no stuffing box.

J. H. Wiggins. U.S.P. 2,415,322, 4.2.47. Pressure Control Mechanism for Fluid Storage Apparatus.—A variable volume storage tank for automatically maintaining fluid contents at a constant pressure. R. B. S.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

1060. Centrifugal Compressors for Gas Pipe-lines. M. C. Shaw and E. T. Neubauer. *Oil Gas J.*, 8.3.47, **45** (44), 65.—The merits and demerits of centf compressors for pumping natural gas from producing fields to consumers, are discussed. The technique is that of using low pressure ratios whilst handling large quantities of gas, a process especially suited to the centf compressor. It is generally possible to eliminate the use

of large gear ratios and this is an advantage when compared with the high-speed multi-stage axial flow compressor. The centf has the advantage of variable capacity, when driven at constant speed, according to the demand on the system. Six methods of regulation of centf compressors are discussed, of which the by-pass method is the simplest. Operation, lubrication, shaft seals, materials, and costs conclude an excellent review. I. G. B.

1061. Cooling-Tower Performance Evaluated for the Operator. J. G. De Flor. *Oil Gas J.*, 29.3.47, **45** (47), 129.—Atmospheric and mechanical draft towers are described, and their performance discussed.

Mechanical Draft Towers.

The two types are :—

(*a*) Forced draught, now losing favour, where air is forced in the bottom and discharged at the top.

(*b*) Induced draught, where air is pulled upwards from the top, and discharged at high velocity.

In both types, performance is governed by ratio of weights of air to water, and time of contact between water and air. These depend on the following factors, of which the required tower size is then a function.

(1) Cooling range (hot water temp minus cold water temp).
(2) Approach to wet bulb temp.
(3) Quantity of water to be cooled.
(4) Wet bulb temp.
(5) Air velocity through the cell.
(6) Tower height.

A series of diagrams and curves is given illustrating the relationship between these conditions, and a number of examples worked out to show how cooling tower performance may be deduced from the curves.

Atmospheric Cooling Towers.

Water is pumped to the top of the tower, and then discharged through a distributing system. Air passes horizontally through the tower. Performance is limited by position, *e.g.* it must be in an exposed area and broadside on to the prevailing wind. The problem of excessive spray loss has now been solved by incorporating drift eliminators into the louvers.

Cooling capacity varies with water concentration, and this depends on :

(1) Temp range.
(2) Approach to wet bulb temp.
(3) Tower height.
(4) Wind velocity.
(5) Wet bulb temp.

The effect of these factors is discussed, and illustrated by curves, and examples are included. W. M. H.

1062. Insulation Technique for Oil-Refinery Structures. S. S. Parker. *Oil Gas J.*, 25.4.47, **45** (51), 160.—The use and advantages of silicate fibres (mineral wool) as insulating material for refinery plant over a 10-year period at Ashland, Ky., is discussed.

The blanket form of insulation materially decreases time and expense of application, and at a lower unit and cost. Repairs can be rapidly carried out, whereas the brick method consumed days of time. Chemical wool is easily applied and retains shape and properties in service. Blankets are held in place, for example, on four asphalt oxidizing tanks by heavy wires butt-welded to the steel plate prior to application of insulation, 2-in thickness of the wool being employed.

Multiple layers of installation can be used, and on large units it is essential that the insulation be applied when dry and be protected from water.

High-pressure steam lines are among other refinery equipment which have been successfully insulated with mineral wool, losses over a distance of more than ¼ ml being between 10° and 15° F at 225 p.s.i. at 550° F. G. A. C.

1063. 50-Ft. Steel Stacks. Refiners' Notebook, No. 137. W. L. Nelson. *Oil Gas J.*, 29.3.47, **45** (47), 177.—Temperature of flue gas is correlated with length of stack and prevailing weather, according to the formula

$$\frac{T_2 - T_A}{T_1 - T_A} = \frac{37\sqrt{V} - 0{\cdot}89\,UH}{37\sqrt{V} + 0{\cdot}89\,UH},$$

where T_2 = inlet temp ° F, T_1 = outlet temp ° F, T_A = air temp ° F, V = volume of flue gas, H = height of stack, U = overall heat-transfer rate, B.Th.U./sq ft/hr/° F temp difference.

A table is included, showing draft produced by 50 ft steel stacks at sea level, with inlet temp of 300° F to 900° F, air temp 0° F to 100° F. For this table, a value of 1·3 is adopted for U, corresponding to conditions of rain and wind; values of U are also given for differing weather conditions. W. M. H.

1064. Stack Size—Furnace Draft. W. L. Nelson. *Oil Gas J.*, 19.4.47, **45** (50), 135.—No. 140 in the *Refiners' Notebook* series shows the size of stacks commonly used when firing gas and oil fuels with chart based on the use of 40% excess air and an average flue gas (60° F) velocity of approximately 7–5 ft per sec. Other notebooks relating to stacks are also listed. G. A. C.

1065. Indian Engineer Assistance Group. The Anglo-Iranian Oil Co., Abadan, Iran. D. A. Goldfinch. *Roy. Engrs J.*, 1947, **61**, 147–153.—When, in 1943, civilian labour available in Iran became inadequate to meet the needs of the Abadan refinery expansion scheme, the Anglo-Iranian approached the British military authorities for assistance from Engineer troops. Information is given regarding the programme of work, organization and technical control, costing and construction records, and various aspects of the operations. G. S.

Cracking.

1066. Modern Refining Processes. Part 16.—Thermal Cracking of Residual Feed Stocks to Liquid Residues. G. Armistead. *Oil Gas J.*, 19.4.47, **45** (50), 94.—Many routine operating arrangements in thermal cracking processes are important in present day practice, although advances are not frequent. Thermal cracking of residual feed stocks led to the use of viscosity-breaking operations with improved yields.

The gas oil cracking steps are an integral part of the process, and tendency to production of coke-limits crack per pass to about 20% of the charge, but this may be considerably raised on selected stocks.

Different type stocks should be segregated in order that each may be cracked under optimum conditions. In two-coil operations employing viscosity breaking on units built by the Kellog Co. coil temperatures may range from 870° F in the heavy oil coil to 1025° F with light virgin gas oil. Cracking rates of 7–10% per pass for heavy oil is desirable.

The permissible crack-per-pass rates may be increased from 9 to 10% to 15% by addition of light hydrocarbons to the cracking stock as in gas reversion of polyform operations.

Six flow sheets illustrate the article. G. A. C.

Polymerization.

1067. On the Catalytic Hydrodimerization of Acetylene under Atmospheric Pressure. L. I. Anzus and A. D. Petrov. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **53**, 619 (in English).—Previous work by the same authors on the hydropolymerization of acetylene over nickel and mixed catalysts at both atm and high pressure had shown that a liquid product, mainly mixed hydrotrimers and hydrotetramers, was obtained, the composition of which was determined. With mixed nickel–zinc catalyst at high pressures, hydrodimers only were obtained, *e.g.* 70% *iso*butylene and 6% divinyl, based on acetylene. The aim of the present work was to obtain a similar yield of *iso*butylene in atm pressure operation. Using a mixed nickel–cobalt–kaolin catalyst at 170° C, a 4 : 1-hydrogen–acetylene feed and a litre-hour-space-velocity of 400–500, the sole product of the reaction is *iso*butylene, as 15% by volume of the exit gas, the

remainder being hydrogen. With a nickel–zinc–kaolin catalyst at 170°, a 1 : 1 hydrogen–acetylene feed and a L.H.S.V. of 200, the products are 15% ethylene and 4% divinyl and no liquid hydrocarbons. The results obtained with variations of these conditions are tabulated. The mechanism of low-temp catalytic hydropolymerization of acetylene proposed to explain these results is compared with the high-temp hydropolymerization-cracking scheme proposed by Sheridan, which is claimed to be inadequate in the present case. G. H. B.

Alkylation.

1068. On the *cyclo*Pentylation of Aromatic Hydrocarbons. P. Cagniant, A. Deluzarche, and G. Chatelus. *Compt. Rend.*, 1947, **224**, 1064.—The *cyclo*pentyl group can be linked to the nucleus of an aromatic hydrocarbon by reacting the latter with *cyclo*pentene at 0° C in the presence of aluminium chloride as catalyst, using good agitation and a reaction time of *ca.* 10 min; with solid aromatic hydrocarbons carbon disulphide is used as a solvent. The reaction is exothermic. The products are mainly mono- and di*cyclo*pentyl, and in some cases, the tri*cyclo*pentyl derivatives. The products obtained from benzene, toluene, *o*-, *m*-, and *p*-xylenes, 1 : 3 : 5-trimethylbenzene, diphenyl, hydrindene, acenaphthene, and anisole are described. The constitution of all the mono*cyclo*pentyl derivatives have been established by permanganate oxidation, and in some cases by an alternative synthetic method. G. H. B.

Special Processes.

1069. Rubber Chemicals from Petroleum. Anon. *India-Rubber J.*, 1947, **112**, 496.—A brief description is given of a new plant for the production of chemicals from petroleum, for use in many industries, including rubber and plastics, which is being erected by the Shell Chemical Manufacturing Co., Ltd., at Thornton-le-Moors, Cheshire. C. N. T.

Metering and Control.

1070. Application of Automatic Control to Gasoline Plant and Refinery Processes. E. H. Reynolds, W. Troutman, and G. Lawn. *Oil Gas J.*, 5.4.47, **45** (48), 66.—The various types of temp, pressure, flow, and liq level instruments are described and the application of automatic control in gasoline plant and refinery processes are discussed for the following: For operation of: (*a*) a de*iso*butanizer column; (*b*) a de*iso*pentanizer column; (*c*) for maintaining the pressure in a refinery fuel–gas system by burning the excess gas under steam boilers; (*d*) automatic means for limiting variations of fuel–gas pressure by the use of a duplex pressure controller which will allow make up gas to go to a system when the pressure drops to a set point, or will vent gas to air if the pressure rises to a predetermined point. Flow charts for these four cases show the points for fixing and types applied. W. H. C.

Safety Precautions.

1071. Fire Control Methods Learned in War. R. B. Tuttle. *Oil Gas J.*, 19.4.47, **45** (50), 84.—Tests with the sub-surface injection method of tank-fire extinguishing are described.

The original method was developed in England in the early days of the 1939–45 war involved injecting chemical foam into the tank through its product lines, and was successful against fuel oil fires.

To combat gasoline and other fuel fires two changes in the original method were made, to produce a foaming liquid with chemical activity which would produce a blanket on the surface of combustible hydrocarbons, using a device which would deliver homogeneous foam under pressure.

Tests were made with a positive displacement pump, a centrifugal pump, compressor and velocity turbulence foam mixer, the unit producing foam from a maximum of 4000 g.p.m. at 50 p.s.i.g. to 3000 g.p.m. minimum for reduced rates.

The foam fluid used is a hydrolized protein solution containing 38% solids and the necessary compounds to react in the presence of heat to give the blanket required. Five fire tests were made, on crude oil, gasoline, and residues from these, using foams

of maximum fire-fighting ability (containing from 23 to 33% water). In test 1, for example, on crude oil at 16 ft 4 in above foam inlet, with pre-burning for 3 min, foam applied at 0·47 g.p.m. per sq. ft. for 7 min, the fire was extinguished in 8 min 15 sec. A temp of 675° F was reached as extinguishment began; this fell to 120° F 3 min afterwards, when the fire was under control. G. A. C.

Refining Patents.

1072. **Patents on Refining Processes and Products.** C. Arnold (S.O. Dev. Co.). B.P. 586,871, 16.4.47. Lub. oil compositions.

J. C. Arnold (S.O. Dev. Co). B.P. 586,848, 16.4.47. Manufacture of triptane.

Standard Oil Development Co. B.P. 586,839, 16.4.47. Normally solid metal-fabricating lubricants.

Standard Oil Development Co. B.P. 586,841, 16.4.47. Inhibition of oxidation in hydrocarbon oils.

Usines de Melle. B.P. 586,829 and B.P. 586,831, 16.4.47. Hydration of olefines.

T. O. Wilton. B.P. 586,798, 16.4.47. Distillation and fractionation of tars, oils, and like liquid hydrocarbons.

E. Zimkin. B.P. 586,790, 16.4.47. Refining of benzole.

C. Arnold (S.O. Dev. Co.). B.P. 587,080, 23.4.47. Process and apparatus for the low-temperature polymerization of olefines.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,088 and B.P. 587,013, 23.4.47. Motor fuels.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,048, 23.4.47. Destructive hydrogenation of petroleum.

J. G. Fife (Shell Dev. Co.). B.P. 586,945, 23.4.47. Catalytic processes.

Standard Oil Development Co. B.P. 586,914, 23.4.47. Production of hydrogen.

Standard Oil Development Co. B.P. 586,992, 23.4.47. Treatment of shale.

Aladdin Industries Ltd. B.P. 587,207, 3.4.47. Burner construction for gasoline mantle lamps.

C. Arnold (S.O. Dev. Co.). B.P. 587,168, 30.4.47. Production of aromatic amines.

C. Arnold (S.O. Dev. Co.). B.P. 587,193, 30.4.47. Preparation and employment of catalytic materials.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,241, 30.4.47. Treatment of hydrocarbon mixtures to effect segregation of desired hydrocarbons.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,258, 30.4.47. Manufacture of greases.

Eagle Oil and Shipping Co. Ltd., R. G. Mitchell and H. C. Tait. B.P. 587,279, 30.4.47. Emulsifying agents.

Shell Development Co. B.P. 587,161, 30.4.47. Preparation of catalysts.

Standard Oil Development Co. B.P. 587,151, 30.4.47. Catalytic dehydrogenation of hydrocarbons.

Standard Oil Development Co. B.P. 587,273, 30.4.47. Diesel fuel compositions.

C. Arnold (S.O. Dev. Co.). B.P. 587,396, 7.5.47. Catalyst manufacture.

C. Arnold (S.O. Dev. Co.). B.P. 587,476, 7.5.47. Catalytic cracking.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,395, and B.P. 587,475, 7.5.47. Low-temperature polymerization processes.

I.C.I. Ltd., I. L. Clifford, E. G. Williams, and R. B. Richards. B.P. 587,391, 7.5.47. I.C.I. Ltd., E. Hunter, C. G. P. Feacham, and R. B. Richards. B.P. 587,378, 7.5.47. Polymerization and interpolymerization of ethylene.

Shell Development Co. B.P. 587,413, 7.5.47. Break in fuel and method for breaking in I.C. engines.

Shell Development Co. B.P. 587,482, 7.5.47. Well-drilling fluid.

J. G. Fife (Shell Development Co.). B.P. 587,314, 7.5.47. Addition of amines to stabilize gasoline.

Standard Oil Development Co. B.P. 587,310, 7.5.47. Lubricating greases.

Standard Oil Development Co. B.P. 587,472. 7.5.47. Production of motor fuels by catalytic cracking.

W. W. Triggs (International Catalytic Oil Processes Corpn.). B.P. 587,456, 7.5.47. Preparation of reduction products of the oxides of carbon.

Anglo-Iranian Oil Co., Ltd. (Soc. de Raffinage des Huiles de Petrole). B.P. 587,561, 14.5.47. Refining of hydrocarbons.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,618, 14.5.47. Manufacture of polymers.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,624, 14.5.47. Production of lub. oils.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,762, 14.5.47. Conversion of carbonaceous materials.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,767, 14.5.47. Catalytic cracking.

Lummus Co. B.P. 587,568, 14.5.47. Recovery of phenol from phenol–brine mixtures by distillation.

Shell Development Co. B.P. 587,557, 14.5.47. Synthetic resins.

Shell Development Co. B.P. 587,584, 14.5.47. Process and catalysts for the production of olefine oxides.

Standard Oil Development Co. B.P. 587,569, 14.5.47. Treatment of bituminous materials.

Standard Oil Development Co. B.P. 587,615, 14.5.47. Isomerization of paraffin hydrocarbons.

Standard Oil Development Co. and J. C. Arnold. B.P. 587,623, 14.5.47. Catalytic treatment of hydrocarbon oils.

E. W. M. Fawcett and J. H. Beynon, assrs to Anglo-Iranian Oil Co. Ltd. U.S.P. 2,410,024, 29.10.46. Liquid-phase isomerization of normal paraffins with $AlCl_3$ in solution in *tetra*chloroethane at an elevated temperature under suitable pressure.

E. L. Lukcas, assr to Chemical Development Corpn. U.S.P. 2,410,034, 29.10.46. Method of reclaiming hydrocarbon and other solvents by distillation and active carbon adsorption.

G. R. Bond, Jr., assr to Houdry Processes Corpn. U.S.P. 2,410,042, 29.10.46. A hydrocarbon oil containing styrene is refined by treatment with gaseous SO_2.

R. E. Burk and E. C. Hughes, assrs to Standard Oil Co. (Ohio). U.S.P. 2,410,044, 29.10.46. An aromatization process using an oxide complex of tin aluminium and chromium as catalyst.

R. E. Burk and T. J. Walsh, assrs to Standard Oil Co. (Ohio). U.S.P. 2,410,045, 29.10.46. Design of a laboratory fractionating column head.

D. L. Campbell, assr to S.O. Dev. Co. U.S.P. 2,410,048, 29.10.46. An absorption process for the recovery of diolefins.

A. W. Horton, assr to Socony Vacuum Oil Co. U.S.P. 2,410,070, A. W. Horton, J. W. Brooks, and A. A. O'Kelly, assrs to Socony Vacuum Oil Co. U.S.P. 2,410,071, and A. A. Horton, J. W. Brooks, and A. A. O'Kelly, assrs to Socony-Vacuum Oil Co. U.S.P. 2,410,072, 29.10.46. Alkylation processes using a gaseous catalyst, such as a halide derivative of a hydrocarbon.

C. H. Hughes, assr to Hughes by-Product Coke Oven Corpn. U.S.P. 2,410,074, 29.10.46. Process of cracking heavy petroleum oils and tars in a refractory coking oven to obtain coke and aromatic hydrocarbons.

R. E. Meyer and F. B. Otto, assrs to Socony Vacuum Oil Co. U.S.P. 2,410,096, 29.10.46. Manufacture of high mol. wt. aliphatic ketones.

A. N. Sachenen, A. A. O'Kelly, and C. G. Myers, assrs to Socony Vacuum Oil Co. U.S.P. 2,410,107–8, 29.10.46. High temperature and pressure catalytic alkylation processes. G. R. N.

PRODUCTS.

Chemistry and Physics.

1073. Acid Quality—Plant and Laboratory. W. L. Nelson. *Oil Gas J.*, 26.4.47, **45** (51), 183.—No. 141 in the *Refiners' Notebook* series gives three columns of figures relating pounds 66° Baume sulphuric acid per brl of oil with % by liq vol and ml of acid per litre of oil. Recent *Notebooks* in the series of particular interest to chemists are also listed. G. A. C.

1074. Purification, Purity, and Freezing Points of 8 Nonanes, 11 Alkyl*cyclo*pentanes, 6 Alkyl *cyclo*hexanes, and 4 Butylbenzenes of the A.P.I. Standard and A.P.I.-N.B.C. Series. A. J. Streiff, E. T. Murphy, J. C. Cahill, H. F. Flanagan, V. A. Sedlak, C. B. Willingham, and F. D. Rossini. *Bur. Stand, J. Res., Wash.*, 1947, **38** (1), 53.—Continuing work on purification and freezing points of hydrocarbons, this report describes the determination of purity and freezing points of a further twenty-nine compounds, including nonanes, alkyl*cyclo*hexanes, alkyl*cyclo*pentanes, and butylbenzenes. Information regarding source, quantities, and dist is given in tabular and graphical form, and a list of references is appended, from which may be obtained details of the procedure followed. W. M. H.

1075. Normal Co-ordinate Analysis of the Vibrational Frequencies of Ethylene, Propylene, *cis*-2-Butene, *trans*-2-Butene, and *iso*Butene. J. E. Kilpatrick and K. S. Pitzer. *Bur. Stand. J. Res., Wash.*, 1947, **38** (2), 191.—In order to make accurate thermodynamic calculations for olefins it is necessary to understand the forces operating round the olefinic double bond. A complete vibrational assignment is available for ethylene and deuteroethylene, and constants determined from this have been used directly, or modified, to calculate vibrational frequencies of propylene and *cis*-, *trans*-, and *iso*-butenes. In some cases, spectral data provided many of the vibrational frequencies of these molecules.

A list of 15 references is appended. W. M. H.

1076. Infra-red Absorption Spectra of Seven *cyclo*Pentanes and Five *cyclo*Hexanes. E. K. Plyler, R. Stair, and C. J. Humphreys. *Bur. Stand. J. Res., Wash.*, 1947, **38** (2), 211.—Infra-red absorption spectra have been measured in the region of 2 to 15 microns for *cyclo*pentane, methyl*cyclo*pentane, 1 : 1-dimethyl*cyclo*pentane, *trans*-1 : 2-dimethyl-*cyclo*pentane, *trans*-1 : 3-dimethyl*cyclo*pentane, *cis*-1 : 2-dimethyl*cyclo*pentane, and *cis*, *trans*, *cis*-1 : 2 : 4-trimethyl*cyclo*pentane; *cyclo*hexane, methyl*cyclo*hexane, 1 : 1-dimethyl*cyclo*hexane, *trans*-1 : 2-dimethyl*cyclo*hexane, and *cis*-1 : 2-dimethyl*cyclo*hexane.

The spectrometer used was a Perkin–Elmer model, with a sodium chloride prism, General Motors amplifier, and Brown recorder. The apparatus and method of use are described, the slit control mechanism in detail.

All hydrocarbons used were highly purified, and wavelengths of all observed absorption bands are tabulated, with a graph of percentage transmission over the wavelength region of each substance. In all cases, a note is made of the bands best suited for distinguishing purposes.

The four dimethyl*cyclo*pentanes proved of special interest, since, although the structural positions of the substituted methyl groups are only slightly different, there is a marked spectral difference. Absorption spectra of 1 : 1-dimethyl*cyclo*pentane, *cis*-1 : 2-dimethyl*cyclo*pentane, *cis*, *trans*, *cis*-1 : 2 : 4-trimethyl*cyclo*pentane, and 1 : 1-dimethyl*cyclo*hexane are here measured for the first time.

Eleven references are given. W. M. H.

1077. Kinetics of the Catalytic Oxidation of Propylene. P. J. Butyagin and S. J. Elovich. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **54**, 603 (in English).—The oxidation and adsorption of propylene was studied by a static method on a barium sulphate-supported platinum catalyst conditioned at 420° C. Adsorption isotherms

were obtained for propylene over temperature and pressure ranges of $+17°$ to $-65°$ C and 10^{-4} to 1 mm mercury respectively, and for oxygen at $-183°$ C over the same pressure range. From the results it was concluded that the catalyst surface was not uniform with respect to the heats of adsorption involved. At higher temperatures the adsorption of both substances varied with time. Oxidation rates were determined for a stoicheiometric propylene–oxygen mixture over the pressure and temperature ranges 0·06–0·8 mm and 40–180° respectively, in which reaction to give carbon dioxide and water was found to be complete. From experiments with packed reactors, etc, it was concluded that the oxidation was a gas-phase process, the rôle of the catalyst being to produce reactive intermediates which were partly desorbed to take part in the gas-phase reaction which was probably of a chain character. This view was shown to be consistent with the observed differences in the forms of the adsorption and rate equations. G. H. B.

1078. Structure of Ethylene Oxide and *cyclo*Propane. C. A. McDowell. *Nature*, 1947, **159**, 508.—The formulæ of ethylene oxide and *cyclo*propane advanced by Walsh (*Nature*, 1947, **159**, 164; see Abstract No. 617 (1947)) are stated to be incorrect because these structures cannot give rise to the known Raman and infra-red spectra, which, however, can be explained by means of the classical formulæ for these substances.

Reply by A. D. Walsh, *Nature*, 1947, **159**, 712.

The structural formulæ previously put forward are defended on wave-mechanical grounds. It is claimed that all the salient facts stated by the critics can be explained qualitatively on this basis. H. C. E.

1079. Molecular Weights in Practice and Theory. A. V. Brancker. *Petroleum*, 1947, **10**, 66.—This is the concluding article of Part II of this series and is called "General Discussion." The first two instalments of Part II reviewed the theory of dilute solutions and the derivation of $\theta = Km$ (where θ is the temperature change, K a constant, and m the molality) from fundamental thermodynamic equations. A modified equation $\theta = Km^b$ was introduced, where b is a constant approaching unity.

Association and dissociation are discussed in this last article and the case of the acetic acid and benzene system is taken up. The author has recalculated published data on this system using the modified equation and obtains constant molecular weights within the limits of experimental error.

The case of *p*-cresol in benzene is also discussed in a similar manner.

Many other cases have been studied on the basis of the equation $\theta = Km^b$ and consistent molecular weights have been found where anomalies previously existed using the classical equation $\theta = K_f m$.

In all cases of solutes in a variety of solvents so far studied the modified equation has given consistent results, and for this reason is recommended at least for routine determinations of molecular weights. F. W. H. M.

1080. Set Time and Particle Size. F. H. Garner, A. H. Nissan, and F. Mayo. *Nature*, 1947, **159**, 708.—In order to dissolve substances of high molecular weight in hydrocarbon solvents, agitation of the suspension for a "set time" (T) until the viscosity of the medium is such that the undissolved particles no longer settle out may be followed by a period during which the remainder of the solute dissolves without further shaking. This idea is developed mathematically, and an equation involving T and the representative size of the original particles is shown to hold in the case of an aluminium soap. H. C. E.

1081. Vibrational Frequencies of Semi-rigid Molecules : A General Method and Values for Ethylbenzene. W. J. Taylor and K. S. Pitzer. *Bur. Stand. J. Res., Wash.*, 1947, **38** (1), 1.—Accurate values for vibrational frequencies are needed for calculation of thermodynamic functions of molecules. A mathematical analysis is given which shows that it is often easier to calculate the kinetic-energy matrix than the reciprocal kinetic-energy matrix of semi-rigid molecules. Formulæ are given reducing calculation of kinetic-energy matrix to masses, moments of mass, and moments of inertia of the rigid groups. Calculations illustrating this are included for ethylbenzene, using force constants determined from propane and toluene, and values for the vibrational fre-

quencies of ethylbenzene have been assigned on a semi-empirical basis from these calculations and spectroscopic data. W. M. H

1082. Antoine Vapour-Pressure Equation for Mononuclear Aromatic Hydrocarbons. N. Corbin, M. Alexander, and G. Egloff. *J. Phys. and Colloid Chem.*, 1947, **51**, 528.—Variations of the constants A, B, and C of the Antoine equation

$$\log p = A - \frac{B}{t + c}$$

with the number of carbon atoms has been investigated for the purpose of estimating the vapour pressures and boiling points of compounds for which experimental data are inadequate. The results show that these properties can be reasonably predicted for the normal alkylbenzene series and the 2-methyl-2-phenylalkane series. For other types of alkylbenzenes the variations are too great. The vapour pressure and boiling point can, however, be predicted for phenyl-substituted normal alkanes if the boiling point at 760 mm is known.

The constants A and B are evaluated and related to the number of carbon atoms at several values of C for the n-alkylbenzene and the 2-methyl-2-phenylalkane series. The relationship of A and B to C are given for the n-alkylbenzene series. Application of the results for estimation of vapour pressures at different temperatures or boiling points at pressures of 10 to 800 mm are discussed. J. T.

1083. Influence of Spray Particle Size and Distribution in the Combustion of Oil Droplets. R. P. Probert. *Phil Mag.*, 1946, **37**, 94.—A theoretical examination of the evaporation of liquid sprays is made using the law of size distribution and the law concerning the effect of size on the evaporation of single droplets. The mean diameter of a spray and the rate of evaporation of given distributions and then variation of liquid volume of a spray during the evaporation are given. The investigations deal only with the effect of distribution and size and not with the mechanism of evaporation. The effect of distribution on combustion intensity and the desirable characteristics of a spray from the point of view of combustion is discussed. Graphs useful for correlating data on the flame length from atomizers and on combustion losses are given. J. T.

1084. Kinetic Energy Correction for the Flow of Plastic Liquids Through Circular Pipes. T. R. Lomer. *Phil. Mag.*, 1946, **37**, 571.—Starting with the general equation of Schofield and Scott-Blair relating the rate of flow of a plastic liquid through a circular pipe to the shearing stress at its walls, the derivation of a kinetic energy correction is fully given. J. T.

1085. An Effect of Electron Bombardment Upon Carbon Black. H. L. Watson. *J. App. Phys.*, 1947, **18**, 153.—A change is reported in the mean particle size and shape characteristics of carbon-black due to specimen contamination while under examination in electron microscopes. The effect is described for a number of commercial blacks and examples are given in graphical form to show the variations in mean particle size with continued bombardment at normal focusing intensities. The effect is also observed in other materials, but is more pronounced in carbon-black. Suggestions are made for minimizing the effect. J. T.

Analysis and Testing.

1086. Study of Asphaltenes by Extraction with Selective Solvents. M. Bestougeff and R. Darmois. *Compt. Rend.*, 1947, **224**, 1365.—Asphaltenes precipitated by petrol ether from a Middle East crude and a Venezuelan asphalt were successively extracted with gasoline fractions of increasing boiling range followed by blends of gasoline and benzene. The yields, temperatures of immediate fusion, molecular weights, and elementary composition (C, H, S, O + N) of the extracts and residues were determined. At comparable molecular weights the Middle East fractions were less fusible than those from Venezuelan asphalt. The colours of the fractions were not black, but ranged from clear brown-red to deep blue-black. The elementary composition of various Middle East fractions did not differ significantly. The initial fractions were partly distillable (40–50%) without decomposition up to 250° C at 10^{-4} to 10^{-5} mm mercury. It was

concluded from the properties of the solvent-extracted fractions that asphaltenes are part of the heterocyclic constituents of petroleum and asphalt which follow heavy hydrocarbons in a sequence of increasing molecular weight. G. H. B.

1087. Use of Ferrocyanide as a Reducing Agent in Analysis. Application to the Determination of the Saturation Index by Chlorination by the McIlhiney Method. V. Sinn. *Chim. Anal.*, 1947, **29**, 84.—When chlorine is substituted for bromine in the McIlhiney test the determination of excess chlorine and of the hydrochloric acid formed can conveniently be carried out by absorption in a ferrocyanide solution of known strength. 20 ml of $N/3$ potassium ferrocyanide is fed through the bromine funnel into the reaction flask, maintained at 0° C. After vigorous shaking the acid is titrated with $N/10$ NaOH using phenolphthalein as indicator. There is then added 60 ml of water, 10 ml of 20% H_2SO_4 and 2 drops of phenanthroline indicator and the excess ferrocyanide is titrated with $N/10$ cerium sulphate. A clear colour change from orange to yellow-green is observed at the end-point. A blank test is carried out at the same time.

V. B.

1088. Gas Blending System. A. Langer. *Rev. Sci. Instrum.*, 1947, **18**, 101.—Details are given of an apparatus for making mixtures suitable for calibration of mass and infra-red spectrometers. The apparatus comprises a multiple volume gas pipette, a sintered disc valve impervious to mercury, but pervious to gases, and a pressure gauge. In principle, the pressure of each component is measured separately before transferring it to a storage vessel; and it is claimed that the composition of mixtures as blended and by determination with a mass spectrometer agree within $\pm 0{\cdot}5\%$. H. C. E.

1089. Strength of Solutions of Doctor, Caustic, and Carbonate. W. L. Nelson. *Oil Gas J.*, 5.4.47, **45** (48), 105.—No. 138 in the *Refiner's Notebook* series gives nomographs which may be used to determine the percentage of strength and weight of chemical in doctor and caustic solutions.

Examples for lead oxide, caustic, and carbonate are illustrated.

The scales may be used to determine lb of chemical in a gal of liquid. G. A. C.

1090. Infra-Red Absorption Analysis of Gases and Vapours. R. Quarendon. *Petroleum*, 1947, **10**, 54.—This article will be published in six instalments and will give a review of the general features of limited radiation analysers, commercial instruments of the L.R. type and precautions in their use, total radiation analysers, and a selected bibliography.

Instalment 1 is a general introduction. The application of infra-red absorption analysis is discussed. Theoretical considerations relating to absorption phenomena are given in some detail. It is stated that the essential condition for the absorption of infra-red energy at any particular frequency is that the atomic or molecular vibration shall result in a periodic change in the dipole moment of the molecule.

Two types of infra-red gas analysers are mentioned, they are limited radiation and total radiation analysers. In the former, the measurements are made at a very narrow range of wavelengths, the instrument being usually known as a spectrophotometer. The latter makes no attempt to sort out the radiation into its wavelengths, but relies on other methods for the necessary selectivity to be obtained, thus conferring the same effect as would be obtained with high resolution. F. W. H. M.

1091. Analysis of a Standard Sample of Natural Gas by Laboratories Co-operating with the ASTM. M. Shepherd. *Bur. Stand. J. Res., Wash.*, 1947, **38** (1), 19.—Subcommittee VII of Committee D-3 of the ASTM has undertaken, in co-operation with thirty laboratories, the standardization of analysis of gaseous fuels. This report describes the volumetric analysis of a standard sample of natural gas by absorption and combustion methods; diagram and description of apparatus, together with details of analytical procedures, are given. Results are shown as frequency distribution plots, from which analyses from all laboratories may be compared easily, and calculated heating value and specific gravity are included and compared with values measured by the National Bureau of Standards. The data show that standardization of methods of analysis is very necessary. W. M. H.

1092. Rheology of Asphalt. J. W. Romberg and R. N. Traxler. *J. Coll. Sci.*, 1947, **2**, 33.—The viscosities of asphalts, measured in a rotary viscometer, can be compared at a rate of shear of 0·1 sec^{-1}, but in certain cases convergence of stress/shear (F/S) curves may lower or effect a reversal of the true viscosities; the same objections apply to viscosity measurements at constant shearing stress, as in the falling coaxial cylinder viscometer. By comparing viscosities at constant power input per unit volume of sample, FS, these ambiguities can be avoided, and in the experiments described $FS = 1000$ has been chosen. The superiority of this method over others is illustrated.

Complex flow may be evaluated by the expression $M = F/S^c$, where c is the slope of the log F/log S plot and M is the value of F when $S = 1$. When $c = 1$ the equation reduces to the simple viscosity relationship.

The elasticity of asphalt, which deforms continuously under stress, can be measured by: (1) Subjecting the sample to alternating stresses the frequency of which is high compared with the relaxation time; (2) Comparing heat losses during viscous flow, measured by the damping effect on a torsional vibration, with the total energy input; (3) Application of Maxwell's equation for deformation of materials $F = GDe^{-t/T}$, where G is the modulus of elasticity in shear, D is the strain in shear in time t, and T is the relaxation time; (4) Measurement of relaxation by following the decrease in shearing stress after shearing is stopped. It is found that (3) is useless for asphalts, for T is a function of temperature, F, and the sample size. If the time for F to decrease to half its original value (relaxation one-half time) is evaluated at values of $FS = 1000$ the elastic effects of different asphalts can be compared.

Nutting's Law of deformation is examined for asphalt, and the physical significance of the constants indicated. It is shown that Nutting's equation cannot hold for all deformations, and if it is simplified, holding F constant, the errors involved are still of the same order as in the original equation, indicating that inaccuracies lie mainly in the shear–time relation. H. C. E.

1093. Review of the Rheology of Bituminous Materials. R. N. Traxler. *J. Coll. Sci.*, 1947, **2**, 49.—The flow of bitumen is discussed under the following heads: measurements of viscosity, simple and complex flow, age hardening, temperature susceptibility, thixotropy, elasticity, filled asphalts, and rheological aspects of (*a*) penetration test, (*b*) ductility test, (*c*) ring and ball softening point.

Viscosities should be measured in a rotating coaxial cylinder viscometer and the results expressed as a rheology diagram (see Abstract No. 1092, *J. Coll. Sci.*, 1947, **2**, 33).

The penetration test is criticized in that the magnitude of necessary corrections exceeds the true value of the consistency, and the adhesiveness of asphalt to steel, for which no correction is possible, is also measured. The ring-and-ball softening point measures consistency, density, thermal conductivity, and heat capacity, all of which vary with temperature. The ductility test likewise depends on factors other than consistency and hence is of little value.

The paper ends with a discussion on the colloidal aspects of asphalts in relation to their rheological properties. A comprehensive list of references is given. H. C. E.

1094. Centrifugal Method of Measuring the Surface Tensions and Interfacial Tensions of Liquids. W. Meyerstein and J. D. Morgan. *Phil. Mag.*, 1946, **37**, 41.—Formulæ for calculation of surface tension and theoretical consideration of the variants of a centrifugal method of measuring the surface and interfacial tension of liquids are described. In this method a tube containing the liquid is placed radially on a horizontal revolving table and the speed of the table at which movement of the liquid occurs is noted. J. T.

1095. Variable Speed Rotational Viscometer. R. Buchdahl, J. G. Curado, and R. Braddicks, Jr. *Rev. sci. Instrum.*, 1947, **18**, 168.—Details of the design and construction of a variable speed rotational viscometer, suitable for measurement of viscosities from 0·1 to 10,000 poises are given. Errors which occur when using the instrument are discussed, and it is claimed that the overall accuracy of viscosity measurements is about ±1%. H. C. E.

1096. Bingham Viscometer and Viscosity Standards. J. F. Swindells. *J. Coll. Sci.*, 1947, **2**, 177.—The primary standard employed is the viscosity of water at 20° C.

The Bingham Viscometer, the method of measurement, and precautions to be observed, are briefly described. To calibrate the instrument with water times of flow t are measured for various applied pressures P, and the product Pt is plotted against $1/t$, when the slope and intercept of the resulting straight line lead to the constants of the instrument. When viscometers have capillaries too large to enable the time of flow of water to be measured accurately, sucrose solutions of known concentration, or special oils, the viscosities of which have been carefully compared with that of water, may be used. A table of viscosities of water at increasing temperatures is given for the calibration of instruments at temperatures other than 20° C.

The change in viscosity with dissolved air and with pressure are discussed, and it is concluded that whilst in the former case the rate of diffusion of air into oil is not normally rapid enough to affect the viscosity, changes in pressure may be corrected for by applying the equation: $F = \frac{1}{\eta}\frac{d\eta}{dP}$, where F represents the fractional change in viscosity η for unit change in pressure P. H. C. E.

Gas.

1097. Application of Liquified Petroleum Gases. H. W. Gustafson and M. G. Cook. *J. Western Soc. of Engrs*, 1947, **52**, 27.—The description, history, and application of the liquified petroleum gases and the general trends in this industry are given. J. T.

1098. Mobile Laboratory for Gas-Condensate Studies. E. H. Koepf. *Oil Gas J.*, 26.4.47, **45** (51), 108.—A mobile laboratory equipped to study various problems relating to gas and gas-condensate systems is described and data obtained in two gas-condensate fields presented.

The unit was used in absorption studies at 1500 to 3000 p.s.i. and can be used at 6000 p.s.i.

Determinations of phase condition of reservoir fluid, dew-point pressures of rich-gas systems, and of pressure, temperature, and % liquid relationship for gas-condensate systems were among studies made.

The equipment includes a 40-h.p. engine driving a 3-phase 12 k.v.a. generator, an instrument air compressor, and special gas compressor, lean-oil pump, and refrigeration compressor. A 40-point indicating potentiometer is included in the control compartment; the rear compartment housing the high-pressure vessels and lines through which the hydrocarbons flow.

An assortment of sharp-edged nozzles are used to find the proper method of sampling two-phase well-streams and to study the effect of changes in sampling rate upon gas–oil ratio; and tables are given showing this effect.

Studies were made in another field to determine the phase condition of the initial reservoir material and to obtain data on condensation of liquid in the reservoir with pressure decline; results show that the material entering the bore is in a single vapour phase, with a dew-point more than 120, but less than 550 p.s.i. below the initial pressure.

Six figures and two tables illustrate the article. G. A. C.

1099. Purification of Natural Gas in Northwestern New Mexico. Van Thompson and R. A. Graff. *Oil Gas J.*, 19.4.47, **45** (50), 116.—The natural-gas purification plant built by Southern Union Gas Co., in the Barker-Dome, New Mexico, is described. The gas contains 15·0 mol % of CO_2 and 1·0 mol % of H_2S.

Purification is by the organic amine process employing a water solution of monoethanolamine. After purification the gas is passed through a glycol-type dehydration plant and rendered safe for pipeline distribution by depressing the dew-point approximately 45° F. Some of the effluent is introduced into the pipeline and the remainder used for repressuring the Dakota sand gas wells. G. A. C.

Engine Fuels.

1100. Motor-Fuel Trends in Relation to Anti-Knock Requirements. T. H. Risk and J. F. Jordan. *Oil Gas J.*, 5.4.47, **45** (48), 78.—The initial upward trend of octane numbers, begun in 1945 following removal of all U.S. government restrictions, has been resumed.

It is predicted that regular-grade fuels of 80 motor method and 88 research, and premium fuel of 85 motor and 95 research rating are likely by 1950.

It is expected that for the next 2 years fuel requirements will follow the pattern of previous years.

The relation of trends in engine design and the anti-knock characteristics of fuels can be investigated by the border-line method of road-knock testing, using a car specially equipped with fixed distributor, an electronic or stroboscopic indicator to determine spark advance and a tachometer. Figures showing borderline knock curve, effect of advanced spark timing on octane rating, etc., are given to illustrate the method.

It is thought that higher compression ratios and improved automatic transmissions will be two car-design changes in 1949 or 1950, and these will influence fuel requirements. For example, fluid torque converters tend to produce vehicles with lower fuel requirements than the same engines with conventional transmission.

The substitution of olefinic blending agents (shown in a figure) makes an improvement in low-speed anti-knock performance of a base fuel, and such a fuel is unlikely to give trouble when the engine requirement increases.

High sensitivity gasolines, made by catalytic and thermal cracking, were studied, and it was found that it is the composition of the lightest and heaviest fractions of the fuel which is of significance. A series of tables giving anti-knock data and hydrocarbon-type analysis are shown, from which it is seen that wide variations in road performance are obtainable with catalytically cracked gasolines depending on type of charging stock catalyst, cracking temperature, and severity of operating conditions. Thirteen figures and 5 tables illustrate the article. G. A. C.

Lubricants.

1101. Rise of Air Bubbles in Lubricating Oils. J. V. Robinson. *J. Phys. and Colloid Chem.*, 1947, **51**, 431.—The mechanism by which additives in a lubricating oil circulating through a high-speed gear pump stabilize the " emulsified " air is investigated by measuring the velocity of rise of air bubbles in a quiescent column of oil containing no additives and in the same oil containing foam inhibitors, and in an oil containing lubricating additives. In an oil containing no additives the bubbles obeyed Stokes' law, but they rose much more slowly in oils containing additives and, moreover, the rate of rise decreased with increasing length of the path. Additives in lubricating oils may impede the rise of air bubbles by forming shells of liquid with a quasi-solid or gel structure around the bubble. A method is given for calculating the thickness of this liquid shell. The maximum thickness of shell calculated from the observed velocities was equal to the bubble radius. J. T.

1102. Investigations on the Synthesis of Hydrocarbons and Oils with Lubricating Properties by the Alkylation of Polycyclic Aromatics. P. Cagniant, A. Deluzarche, and M. Colomb. *Ann. des Mines et des Carburants*, 1945, (4), 456–472.—It is considered that the lubricating oil hydrocarbons of petroleum are composed predominantly of: (*a*) condensed aromatic ring structures carrying substituent groups varying with the viscosity and viscosity index of the oil, possibly with some hydro-aromatic rings involved; (*b*) alkylated polynaphthenes, especially polycyclopentanes. These two hydrocarbon types predominate in " aromatic " and " naphthenic " lubricating oils respectively. The preparation of synthetic lubricating oils of type (*a*) is therefore based on the alkylation of polycyclic aromatic hydrocarbons with alkyl chlorides and α-olefins using Friedel–Craft catalysts. Previous work on the Friedel–Craft alkylation of aromatics is reviewed in detail with special reference to the effect of experimental conditions on the isomerization and polymerization of the initial reaction products. The characteristics of a satisfactory lubricating oil are discussed in relation to chemical structure and the influence of polar groups on " oiliness " considered.

In the experimental section, the products obtained from the reaction of benzene, naphthalene, acenaphthene, diphenyl, fluorene, phenanthrene, fluoranthrene, chrysene, pyrene, and carbazole with, *inter alia*, heptene-1, dodecene-1, ethyl oleate, erucate, and undecylate, *n*-butyl, hexyl, *n*-heptyl, decyl, tetradecyl, and hexadecyl chlorides are described, using aluminium chloride as catalyst in all cases. The products were distilled at 200–300° C at 10^{-3} mm from a modified Kraft flask, and the distillate fractions and

residues characterized by molecular weight, viscosity, and viscosity index. It is concluded that the viscosities of the products are in accordance with expectations based on previous work, and especially with the finding of Mikeska that the viscosity index increases with the length of the substituent group. The products obtained from olefins are also suitable for use as Paraflow-type additives. G. H. B.

1103. Immersion of a Cylinder into a Viscous Medium Contained in an Axially Symmetrical Receiver. S. M. Targ. *Comptes Rend. Acad. Sci. URSS*, **1946, 54**, 305 (in French).—The equations developed by Reynolds to describe the process of hydrodynamic lubrication are applied to a system comprising a cylinder moving at constant speed into a receiver partly filled with a viscous fluid which it displaces by forcing it between the wall of the receiver and the cylinder (*e.g.* an oil-filled shock absorber—Abstractor). Expressions are obtained for the force acting on the cylinder for the cases in which the receiver is either cylindrical or conical. G. H. B.

1104. The Generalized Equations of Reynolds. N. A. Slezkin and S. M. Targ. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, **1946, 54**, 205 (in English).—The approximate solutions of the equations of Reynolds' theory of lubrication can be made more exact, using the method of Leibenson, by taking into account the quadratic inertia terms, on the basis of Prandtl's equations. Prandtl's equations have now been modified by a partial averaging method to give new equations which are also applicable to problems previously studied only by Reynolds' equations. The application of the new expressions to some particular problems, including flow past a plane plate, is briefly discussed. G. H. B.

1105. On the Problem of Refining the Solutions of Reynolds' Equations. N. A. Slezkin. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, **1946, 54**, 121 (in English).—A previous suggestion by Leibenson for increasing the accuracy of Reynolds' approximate equations for lubricating films was examined. It was first shown that Reynolds' equations could also be applied to systems involving high Reynolds' numbers (Prandtl's equations). The solutions were refined according to Leibenson, to give the result that, from the third approximation onwards, it is necessary to consider both the variation of pressure across the thickness of the film and the viscosity terms neglected in the second and third approximations. These refinements are not possible with the curtailed Prandtl equations. G. H. B.

1106. On the Existence of Several Regimes in which Viscous Forces are Linear Functions of the Velocity. J. Huetz. *Compt. Rend.*, **1947, 224**, 1205.—A previous study of the abnormal phenomena encountered during the measurement of the viscosity of a liquid, using a rotation method, had shown that the resulting torque was initially proportional to the angular velocity, but above a certain critical velocity this proportionality was not maintained. The relations between the torque, angular velocity, and viscosity have now been studied with a spindle oil over a range of temperature using two spheres of different diameters in a concentric spherical enclosure. The curves of torque against angular velocity, containing viscosity as a parameter, are found to be composed of several sections, intersecting at well-defined points at which the slopes change. In general, the slopes of the segments are greater than the calculated values, but with an oil of greater viscosity a segment with the calculated slope and passing through the origin of the co-ordinates is obtained. It is suggested that the groups of segments found arise from the existence of a distribution of velocities in the system of two concentric spheres in relative rotation. G. H. B.

1107. On the Viscous Torque Between two Concentric Spheres. M. Aubert and J. Villey. *Compt. Rend.*, **1947, 224**, 1271.—Previous work had shown that the viscous torque developed across the above system filled with a viscous liquid, when one sphere was rotated at a uniform velocity about a diametrical axis, was greater than that calculated from classical hydrodynamic theory, but that the anomalies disappeared at high fluid viscosities. The basis of the classical calculation is considered and the factors responsible for the discrepancies are considered to be: (*a*) inadequacy of Stokes' law due to fluid slip at the surfaces of the spheres, and (*b*) the existence of non-classical, possibly helical trajectories of fluid motion. The value of visual observations of fluid trajectories

(Charron, *Compt. Rend.*, 1946, **223**, 1078; 1947, **224**, 373) is indicated, and it is suggested that this may indicate in what respects Stokes' equations may need to be modified. It is pointed out that Charron observed circular trajectories for fluids of high viscosity, in agreement with classical theory and the existence of a normal viscous torque. G. H. B.

1108. A Tribometric Method of Measuring Adsorption on a Solid-Solution Interface: Application to the Study of the Lubricating Action of Adsorbed Layers. B. Derjaguin and M. Smoliansky. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **54**, 137 (in English).—An improved method for studying the small concentration changes encountered in the adsorption of a solute from solution at a solid-solution interface was devised by: (*a*) reducing the volume of solution used to a thin film, and (*b*) calculating concentration changes in the solution after adsorption equilibrium had been established from measurements of the coefficient of static friction (μ) across the solution film. The lubricant films used were solutions of fatty acids or higher alcohols in vaseline free from polar impurities, and were deposited on flat steel test-plates by a method based on the controlled passage of the meniscus of a solution of the lubricant in benzene along the test-plate by a siphoning technique. The benzene evaporated to leave a lubricant film of known thickness, calculable from a previously established equation. The concentration of polar solute in the lubricant film after adsorption equilibrium had been established was determined from the value of μ, determined by a slider method, the relation between μ and solute concentration having been determined in preliminary experiments with thick films of known solute concentration. From experiments over a range of initial solute concentration and film thickness, adsorption isotherms for stearic, palmitic, myristic, and caproic acids, and octyl and cetyl alcohols, all on steel at 12–15° C, were determined. The relation between the solute concentrations in the adsorbed films and the frictional characteristics were determined, and it was concluded that some degree of metal-to-metal contact between the slider and plate persisted until the adsorbed solute layer was completely established. G. H. B.

1109. Friction and Wear. E. J. W. Whittaker. *Nature*, 1947, **159**, 541.—When a material comprising 69% wt calcite and 31% *o*-cresol formaldehyde resin was rubbed under standard conditions against mild steel, 726 k-cals of frictional work resulted in the abrasion of 1 g of material. The amount of work required for abrasion is a maximum if all the material is removed as single atoms, and a calculation shows that the heat of atomization of 1 g of the composite material is 10·6 k-cal. Therefore, the maximum proportion of frictional work to be ascribed to abrasion is 1·4%. No allowance was made for wear of the steel member. H. C. E.

1110. Rheology of Lubricants. R. B. Dow. *J. Coll. Sci.*, 1947, **2**, 81.—Improvement in the lubricating properties of oils obtained by adding chemical compounds is discussed from a physico-chemical standpoint. Thus the efficacy of benzotrichloride or tricresyl phosphate in E.P. lubricants is attributed to the liberation of chlorine or phosphorus atoms which unite with the metal surfaces to give low wear qualities.

The susceptibility of lubricants to oxidation is briefly discussed, and it is shown that although mononuclear aromatics cause oils to have poor oxidation resistance, polynuclear aromatics are very stable.

The effect of pressure on the viscosity characteristics of lubricants is discussed at length. Attempts have been made to combine the pressure and temperature effects on viscosity into a single equation, so far without marked success; although equations resting on a semi-theoretical basis are presented. The pressure coefficient of viscosity, α, defined as $\alpha = \frac{1}{P}(\log \eta - \log \eta_0)/\log \eta_0$ where η and η_0 are the 100° F viscosities at pressures P and atmospheric respectively, is found to bear a linear relation to the aniline point in ° C of mineral oils from widely differing sources.

A study of viscosity at high pressures by compressing the oil between anvils and measuring the torque required to twist the anvils under a given thrust shows that, after a sharp initial rise, the shearing stress increases slowly with angle of shear. Results on mineral oils with and without additives, and fatty acids, are given. At high pressures the viscosity becomes infinite and the oil solidifies.

The paper closes with a short theoretical section on the rheology of lubricants, and with a list of 30 references. H. C. E.

1111. Some Recent Advances in Non-Newtonian Viscosity. H. Eyring and G. Halsey. *J. Coll. Sci.*, 1947, **2**, 17.—The paper discusses deviations from normal stress/shear relationships in terms of a mechanical model. H. C. E.

1112. Use of a Blowing Method for Characterizing the Fluidity of Lubricating Oil Films as a Function of Temperature. M. Koussakov. *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **54**, 145 (in French).—A film of oil on a highly polished surface is made to assume a wedge form by directing on it a stream of air from a suitable slit system. When the film is sufficiently thin, light reflected through it forms a system of interference fringes, the spacing of which depends, *inter alia*, on the fluidity of the oil and the pressure gradient of the air stream. If a temperature gradient is maintained across the film normal to the direction of the air stream, the interference fringe system is curved instead of parallel, due to the variation of film fluidity with temperature. By calibrating a given apparatus under fixed conditions with an oil of known fluidity-temperature characteristics, the corresponding data can be obtained for other oils. By examining photographs of the interference fringe system with a microphotometer, oil fluidities can be measured with a precision of 1–2%. G. H. B.

1113. Crankcase Oil Filtration in Motor Vehicles. E. A. Smith. *Petroleum*, 1947, **10**, 58.—The various functions and designs of filters are discussed, and comparison is made of filter elements with their efficiencies.

The filter elements discussed include pure wool felt, asbestos or slag wool, cotton flock, cotton waste, thin metal plates or leaves, magnetized annuli. Their microscopic structure, pore sizes, and special features are tabulated.

Efficiency of filter elements is assessed on the type of foreign matter removed under service conditions with particular reference to road dust, metal, and asphaltic material. F. W. H. M.

1114. Fouling of Engines. J. L. Van den Minne. *Ingenieur*, 18.4.47, (16), 27.—It is suggested that the fouling of engines is due to the breakdown of the lubricant in one of three ways.

(*a*) Oxidation in the liquid phase forming deposits precipitated by petroleum ether.
(*b*) Oxidation in the vapour phase forming lacquers.
(*c*) Oxidation to carbon.

In order to diminish these reactions the addition of anti-oxidants, detergents, peptizing agents or lubricating oil additives of the calcium di-*iso*propylsalicylate type is recommended. Several photographs of the effect of peptizing agents are appended.

These additives and other agents are not recommended for use in jet and turbine engines. N. C.

Special Hydrocarbon Products.

1115. Waxes and Similar Substances in the Rubber and Allied Industries. W. S. Penn. *Petroleum*, 1947, **10**, 56.—The second instalment of this article is entitled "Other Applications." Paraffin wax is used as an electrical insulator because, since it consists of hydrocarbons, it has no polar groups. It is therefore unaffected by electric currents particularly of the high-frequency type. Paraffin wax does not possess good mechanical properties, its melting point is comparatively low, it has inferior tensile strength and is easily scratched, etc.

Polythenes, although otherwise very similar to paraffin wax, have good tensile strength, excellent flexibility, and are fairly resistant to deformation. Although both paraffin wax and polythene possess the same empirical formula, the former contains only about 30 carbon atoms whereas the latter can contain several thousand.

Polythene is used extensively in high-frequency applications—*e.g.* Radar. Owing to its excellent resistance it is used as a protective coating.

Polythene is prepared by polymerization of ethylene at high temperature and pressure in the presence of oxygen as catalyst.

Its properties are :

Tensile strength p.s.i.	8000
Impact strength ft lb/in of notch	Very high
Volume resistivity ohm/cm³	3×10^{17}
Electric strength 50 c/s	1000
Dielectric constant 50 c/s	2·4
" " 10^6 c/s	2·3
Power factor 50 c/s	0·0001
" " 10^6 c/s	0·0002
Sp. gr. between +100° C and −100° C	0·85–0·96

It retains its flexibility down to −70° C. Compared with paraffin wax it is so tough that a plasticiser is required for extrusion work, polyisobutylene being usually employed.

Other thermoplastics and insulators include P.V.C., polystyrene, perspex, and nylon which have well known applications. They are wax-like materials and are very useful in the electrical and allied industries, particularly where ordinary waxes, such as paraffin wax, refuse to function. The electrical properties of these materials are :

	Nylon	Perspex	Poly-styrene	P.V.C.
Tensile strength	7000	8000	7000	3000
Impact strength ft lb/in of notch	—	0·25	0·4	—
Volume resistivity ohm/cm³	10^{13}	10^{16}	10^{16}–10^{19}	$1–3 \times 10$
Electric strength 50 c/s	—	500	600	600–2000
Dielectric constant 50 c/s	3·2	3·35	2·6	7·5
" " 10^6 c/s	3·6	3·2	2·7	—
Power factor 50 c/s	0·01	0·07	0·0002	0·10
" " 10^6 c/s	0·022	0·03	0·0003	—
Sp gr at 25° C	1·10	1·18	1·06	1·2–1·6

Waxes can be used as anti-tack as well as tack-producing compounds. Synthetic rubbers, such as GR-S, lack tackiness. This can be remedied by addition of tackifiers. In extensive use are tars, shellac, liquid petroleum residues, coumarone, indene and polystyrene resins and thermoplastic phenolics. The latter was first used by the Germans in their Bunas.

In order to obtain a highly polished finish on plastic or rubber compounds, wax is either incorporated into the formulæ or the finished article is impregnated with wax.

The mix for rubber flooring, for instance, contains 3% of paraffin wax. The wax is usually incorporated in the formulæ for rubber compounds. For polishing plastics wooden pegs are treated with a wax mixture and introduced into a rotary barrel with the articles to be polished. This is rotated at 30 r.p.m. for about ¼ to 1½ hr.

Wax-like materials used as adhesives for bonding purposes include polyvinyl acetate, shellac, and other thermoplastics.

Introduction of paraffin wax into rubber mixtures reduces deterioration due to oxidation. Polyvinyl alcohol is used as a sizing agent in textiles Waxes and synthetic resins are often used jointly as water-proofing agents.

Waxes and synthetic resins are used to make laminated boards.

It is concluded that waxes of all types are indispensable in the rubber and allied industries. Including thermoplastics among the waxes, the usefulness of waxes may be expected to grow. Purity of the waxes, as regards presence of polar impurities, is adjudged of prime importance, especially in the electrical industries. F. W. H. M.

Derived Chemical Products.

1116. Carbon-Black Faces Progressive Changes. G. Weber. *Oil Gas J.*, 3.5.47, **45** (52), 94.—The transition of the carbon-black industry from channel to furnace process is discussed.

The furnace process gives higher yields, a wider range of products, and has possibilities for further development.

Recent technique has improved the quality of furnace blacks so that they now compete with blacks from the channel process, although there is still a great demand for the latter product from rubber manufacturers.

The furnace process originated in 1920, and for 15 years played a minor rôle, but in 1946 nearly half the total output was from this process, over 514 million lb being produced in 1945.

16 plants operate the furnace process as against 59 channel units.

In the furnace process the free flame method is used, temperatures exceeding 2000° F being reached when the gas is burnt. Quenching takes place at about 1200° F, with final contact with water sprays to reduce the temperature to 450° F. Settling takes place in the electrical field of the precipitator, cyclones deal with black entrained in the gas flow.

Close control is necessary to ensure uniformity of product.

Initial cost of a furnace plant is twice that of the channel unit of same output.

G. A. C.

Miscellaneous Products.

1117. Hydrocarbon Polymer Derivatives. Anon. *Paint Technol.*, Feb. 1947, **12**, 64.—The production of high-mol wt hydrocarbon polymers, containing both chlorine and sulphur, is described in U.S. Patent No. 2,283,627 granted to A. H. Gleason, assigned to Jasco Incorp., Barton Rouge. An example given takes 50 g polybutene, dissolves it in CCl_4 and makes it up to 1 l. To this 50 cc sulphur monochloride dissolved in CCl_4 is added and the solution is kept at 77° C, chlorine being passed in for 4 hr. It is then cooled to room temp and on addition of *iso*propyl alcohol a tough rubbery product is precipitated which contains 1·64% sulphur and 16% chlorine. Such products have particularly high resistance to acids, alkalis, and oxidizing agents, and may be used for coating and impregnating agents or to replace rubber, either wholly or partly, for such purposes as the lining of tanks, etc. W. H. C.

1118. Sulphur Dioxide-Olefine Products (Resinous Polymers). Anon. *Paint Technol.*, Feb. 1947, **12**, 75.—U.S. Patent No. 2,283,900 issued to M. M. Barnett and assigned to Freeport Sulphur Co., New York, gives details of the manufacture of resinous polymers by the action of SO_2 on olefins (ethylene, propylene, butene-1, and butene-2) by polymerization, in the presence of a catalyst, at low temp in a pressure bomb. The rate of reaction and yields are stated to be increased if the catalyst employed is a mixture of a terbene peroxide and a halogen acid, or a material that hydrolyses to give a halogen acid. An example is given in which 0·5% ascaridole, followed by 1% HCl in alcohol, is added to a mixture of butene-1 and SO_2 in mol ratio of 2 : 1 cooled by dry ice and ether. Reaction is completed in about 30 min on allowing the container to rise to room temp. Yields of 85–90% are claimed. The presence of acid results in better coloured products for coating materials. W. H. C.

Engines and Automotive Equipment.

1119. Chromium-Treated Cylinders. Anon. *Oil Engine and Gas Turbine*, 1947, **14**, 384.—The electrolytic plating of cylinder bores, to a thickness of from 0·004 in to 0·020 in, results in an improvement in surface hardening and wearing properties. It is essential that the bores are concentric, and are properly cleaned and prepared in order to prevent the chromium peeling off after application. After plating, the bores are honed and are then cleaned by a jet of high-pressure steam to remove any particles left from honing.

With chrome-hardened bores, oil consumption and ring wear are slightly above normal for the first 1000–1500 miles of running, after which they become less than normal, an improvement which is maintained far longer with the common bore materials. Cast iron piston-rings give the most satisfactory results, used in conjunction with either aluminium or cast iron pistons. Chromium-plated cylinders do not require so much " bedding-in " as plain cast iron bores, and pistons and rings should, therefore, be fitted with larger clearances.

In oil engines, the quality of the fuel when chromium-hardened cylinders are used is apparently immaterial, as chromium is resistant to wear of both abrasive and corrosive types. In certain cases, lower quality lub. oil may also be used, providing it does not cause varnishing of the bore.

If no distortion is present the average life of a cylinder bore is increased from four to ten times by chromium plating. C. D. B.

1120. Silencing Internal Combustion Engines. J. G. Peirson. *Oil Engine and Gas Turbine*, 1947, **14**, 399.—Noise in the exhaust of an I.C. engine can be produced by (1) direct impact of the exhaust gas "wad" upon the atmosphere, when that wad reaches the end of the exhaust pipe, (2) reversation in the exhaust pipe of the noise produced by the above impact, and (3) resonance in the exhaust pipe caused by the air inrush after the departure of the high velocity wad of gas.

To prevent this noise, silencers of various types have been designed: (1) a resonator type, in which various kinds of resonator chambers are used, (2) an absorption type, in which the exhaust noise is absorbed by means of an air-celled sound-absorbent material, such as "glass silk" surrounding a perforated steel tube, (3) a combined absorption-resonator type, and (4) a diffuser and expansion type, in which the exhaust gases are "diffused" through perforated tubes in one chamber, and by-passed for further diffusion and expansion in another chamber or chambers. C. D. B.

1121. Guide to Aircraft Power-Plant Selection. A. L. Lowell. *Aero. Engng Review*, April 1947, **6**, 22.—Deals with increasing number of practical methods of propulsion available to aircraft designer, viz. and draws the following conclusions:

(1) The rocket is not an economical prime mover for aircraft, other than short-range missiles, in the above speed and altitude range.

(2) The subsonic ram-jet is economical only for ranges of the order of 200 miles or less. Assisted take-off and acceleration to operating speed will be required for this power plant.

(3) The turbo-jet is an economical aircraft prime mover at high speeds and low ranges. Comparatively low take-off thrust characteristics may require assisted take-off for overload conditions.

(4) The turbo-prop is the most economical power-plant type for moderate to long ranges at cruising speeds now considered appropriate for bombers and high-speed transports. Take-off thrust characteristics are good.

(5) At speeds corresponding to maximum efficiency for conventional airframes, the reciprocating engine is the most economical power plant. This power plant is most suitable, therefore, where transportation in terms of ton–miles is the primary requirement. As in the case of the turbo-prop, take-off thrust characteristics are good. I. G. B.

1122. Performance Calculation for Jet-Propelled Aircraft. R. K. Page. *J. R. Aero. Soc.*, 1947, **51**, 440.—An analytical method is developed for calculating the speed and climb performance of jet-propelled aircraft, given the drag and thrust data. A method is also given for dealing with the effects of compressibility and the results in a typical example are included to illustrate the form of curves obtained. I. G. B.

1123. Systematic Analysis of Thermal Turbo-jet Propulsion. Anon. *J. Aero. Sci.*, 1947, **14**, 197.—The propulsion unit is divisible into six sections: free inflow, intake, compressor, heat chamber, turbine, and exit nozzle. It is treated uniformly by the quintuple system of dynamic and thermodynamic flow equations with their power or heat inputs, the conditions of change of state (cycle), the continuity equations and the thrust equation. These equations also comprise in each section the retarding forces and the heat creation of turbulent flow and the loss of mechanical power and of heat leakage. They form successive sets of equations, and their solution is derived in terms of the required data of altitude, flying speed, thrust, pressures in front and at the exit of the compressor, permissible entrance temperature at the turbine, and permissible ratio of power of compressor and turbine to heat input. I. G. B.

MISCELLANEOUS.

1124. Petroleum Reserves Brought Up to Date. Anon. *Petrol. Engr*, Mar. 1947, **18** (6), 245.—Statistical data are presented on the discoveries, production, and reserves estimations of oil in the United States during recent years. Within the continental

limits of the United States there are 24,194,587,000 brl of proved liquid hydrocarbon reserves and 160·6 trillion cu. ft. of proved natural gas reserves, as of December 31, 1946. R. B. S.

1125. Petroleum Industry in Chicago Area. G. Egloff. *J. Western Soc. of Engrs*, 1947, **52**, 16.—The history of the 8 oil companies located in the vicinity of Chicago is given. These are the Standard Oil Company (Indiana), Sinclair Refining Company, Globe Oil and Refining Company, Cities Service Company, Pure Oil Company, and Universal Oil Products Company. J. T.

1126. Position of Penn Grade Industry is Improved in 1946. G. G. Bauer. *Producer's Monthly*, Feb. 1947, **11** (4), 24.—Statistical data are presented on the well completions, average daily crude oil production, and average daily crude runs to stills for the Pennsylvania region during 1945 and 1946. R. B. S.

1127. Venezuela Maintains Second Place Amongst Petroleum Producing Countries. A. N. Sutton. *Ind. Min.* (*Argentina*), 1947, **6** (67), 31–35.—Venezuela became the second largest oil producer in the world in 1945, with a production of 323,361,000 brl. This figure was surpassed in 1946 with a total of 391,482,000 brl, an increase of 21%. The three principal producing companies (Creole, Shell, and Mene Grande) accounted for 95% of this total. Details of exploratory drilling and production of the various fields, together with maps of the localities covered, are given. A. C.

1128. Petroleum Highlights in Venezuela. H. H. Power. *Petrol. Engr*, Oct. 1946, **18** (1), 124.—A general description is given of the country and conditions, together with a short account of petroleum concessions, investments, drilling and production practice, pipe-line, and port facilities. G. D. H.

1129. United Kingdom Petroleum Trade in 1947. Anon. *Petrol. Times*, 10.5.47, **51**, 427.—Details are given of United Kingdom petroleum imports and exports for March and the first quarter of 1947, together with comparative figures for corresponding periods of 1946 and 1938. R. B. S.

1130. The Italian Petroleum Industry and its Rehabilitation. Anon. *Petroleum*, 1947, **10**, 52.—The rehabilitation of the petroleum industry is a problem of great importance to Italian economic reconstruction. Appreciable methane resources have been discovered which could possibly be used to replace oil for certain transport and heating requirements. Statistics show that in pre-war years Italy tended to buy crude oil and refine it at home. Increased duty on refined products fostered the construction of new refineries.

At the outbreak of war Italy had 14 distilling and cracking plants with a capacity of about 2 million tons of crude oil a year. Two large hydrogenation plants were also in operation. Roughly one-third of these are now outside Italian territory. For various reasons the demand for oil and petroleum products on the Italian market has now increased. In northern Italy this demand has been partly met by methane-gas production which amounts to 40 or 50 million cu m yearly and which is likely to be increased as a result of the important discoveries made.

After the armistice, Italy received through U.N.R.R.A. about 40–50% of the oil and petroleum products imported before the war. Towards the end of last year the Italian Government and leading oil companies came to an agreement whereby U.N.R.R.A. purchased crude oil overseas and had it refined in Italy.

Reconstruction of the war-damaged refineries is proceeding, but since Italy is losing control of the refineries in the Fiume and Trieste areas, construction of new ones has become necessary to maintain the economics of the country.

The rehabilitation plans for refineries resulting from the agreement between the Italian Government and the oil companies include provision for the reconstruction of catalytic cracking plants.

The financial difficulties of the Italian Government are, however, hampering progress and very little currency is available for purchase of crude oil.

Efforts are being made to rehabilitate the Italian oil wells and an American company

has recently been granted an oil concession in Sicily. It is stated that other foreign oil companies are interested in the possibility of prospecting for oil in Italy.

Efforts are also being made by the Soviet Union to share in the Italian oil market through Rumanian and Hungarian owned companies in Italy.

Italy is endeavouring to obtain foreign oil supplies by offering Italian goods in return for petroleum products. E. W. H. M.

1131. Factors Affecting Quality and Supply of Combustion-Engine Fuels. W. N. Holaday, R. E. Albright, T. L. Apjohn, and E. F. Miller. *Oil Gas J.*, 26.4.47, **45** (51), 112.—Consideration is given to past, present, and future petroleum product fuel supply and demand.

Trend in consumption of all petroleum products in the U.S. is presented graphically, as well as relative consumption, fuel oil distribution by type of stock, consumption of motor fuel, distribution of cracked motor gasolines, trends in auto-knock quality, % cars giving trace knock or loss as a function of O.N. and engine speed, Reid vapour pressures, variation of regular-grade motor-fuel volatility, and possible starting temperature. Other tables include characteristics of motor gasoline fractions from catalytic cracking and estimated characteristics of future diesel fuels. The article is illustrated by 4 charts and 13 figures. G. A. C.

1132. Position of Natural Gasoline and the N.G.A.A. in the Petroleum Industry. J. H. Dunn. *Oil Gas J.*, 26.4.47, **45** (51), 121.—A discussion of the current economic condition of the natural-gasoline and cycling industry, with suggestions for meeting some of the problems is presented.

Many natural-gasoline plants have been abandoned because of instability of the market for their products.

Competitive prices for these products on the basis of a steady flow into the over-all petroleum-products picture should enable the independent operator to take his proper place in the industry.

Studies made by the Natural Gasoline Association of America show, for example, that 1,000,000 brl of butane could be added to winter grade motor fuels.

The anti-knock properties of straight-run type fuels and other aspects, such as engine deposits, varnish, and sludge, are being compared with highly cracked stocks.

Plant-control tests are being correlated, and improvement of separation and synthesis processes by spectrophotometric methods are under study.

High-pressure absorption in the 500 to 3000 p.s.i. range, is being investigated, and present specifications and test methods are being reviewed. G. A. C.

BOOKS RECEIVED.

1946 Book of A.S.T.M. Standards Including Tentatives. Parts IIIA and IIIB. Philadelphia, Pa.: American Society for Testing Materials, 1947. Pp. (Pt. IIIA) 1290 + xxv; (Pt. IIIB) 1360 + xxx.

Normally a triennial publication, exhaustion of supplies of the 1944 edition has necessitated production of the present edition with only a two-year interval. Opportunity has also been taken to divide Part III on Non-metallic Materials into two sections. The first section covers Coal and Coke, Gaseous Fuels, Petroleum, Aromatic Hydrocarbons, Soaps, Water, Textiles, Thermometers, and the second section deals with Electrical Insulating Materials, Plastics, Rubber, Paper, Shipping Containers, Adhesives, Thermometers.

The Chemical Constitution of Natural Fats. T. P. Hilditch. 2nd Edn. London: Chapman and Hall, Ltd., 1947. Pp. 554 + xiii. 45*s*. net.

Following a general survey of the natural fats, succeeding chapters discuss the component acids of fats of (*a*) aquatic flora and fauna, (*b*) land animals, and (*c*) of vegetable fats; the component glycerides of (i) natural fats, (ii) vegetable fats, and (iii) of animal fats. The biochemistry of fats follows and then chapters on constitution of individual natural fatty acids, and on synthetic glycerides. Finally, there are notes on the experimental technique employed in the quantitative investigations.

Transactions of the Institution of Chemical Engineers. Vol. 21, 1943. London: Institution of Chemical Engineers, 1947. Pp. 60 + xx.

Included in this volume are papers on "Solvent Extraction of Lubricating Oils," by H. Ter Meulen, and "Petroleum as a Base Material for Chemical Industry," by J. C. G. Boot.

Transactions of the Institute of Marine Engineers. Vol. 57, Session 1945–46. London: Institute of Marine Engineers, 1947.

In this volume of the transactions of the Institute of Marine Engineers are included papers on "The Proper Care of Lubricating Oil in Service," contributed by the Marine Lubricants Committee of the Petroleum Board, and "The Evolution of Tanker Design," by W. Lynn Nelson.

Reports on Fuel Economy Since 1939. London: World Power Conference, 1947.

Further reports in the series prepared for the Fuel Economy Conference, 1947, are:

Argentine. Pp. 6. 6*d*.
Australia. Pp. 10. 6*d*.
Austria. Pp. 4. 4*d*.
Czechoslovakia. Pp. 4. 4*d*.
Germany. Pp. 8. 6*d*.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	296 A
Geophysics and Geochemical Prospecting	299 A
Drilling	300 A
Production	301 A
Oilfield Development ...	302 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	303 A
Distillation	305 A
Cracking	305 A
Isomerization	306 A
Chemical and Physical Refining	307 A
Special Processes	308 A
Metering and Control	308 A
Safety Precautions	309 A
Refining Patents	310 A
PRODUCTS.	
Chemistry and Physics ...	313 A
Analysis and Testing ...	315 A
Crude Oils	316 A
Engine Fuels	317 A
Gas Oil and Fuel Oil	317 A
Lubricants	317 A
Bitumen, Asphalt, and Tar ...	318 A
Special Hydrocarbon Products	318 A
ENGINES AND AUTOMOTIVE EQUIPMENT	319 A
MISCELLANEOUS	321 A
BOOKS RECEIVED	323 A

AUTHOR INDEX.

The numbers refer to Abstract Numbers.

Adams, C. E., 1202
Alty, H. J., 1202
Amero, R. C., 1192
Anthony, B. L. P., 1202
Appell, F., 1229
Ariano, R., 1217
Armistead, G., Jr., 1186
Arnold, C., 1202
Arnold, J. C., 1202

Balandin, A. A., 1190, 1191
Barral, J., 1194
Barton, J. M., 1134
Bass, N. W., 1140
Bens, G. F., 1231
Berger, H. G., 1202
Bland, R. B., 1187
Bowden, S. T., 1206
Brown, L. C., 1189
Burgoyne, J. H., 1200

Cantrell, R., 1133
Carre, L., 1230
Cave, W. T., 1207
Charron, F., 1212
Chibisoff, V., 1184
Clark, N. O., 1201
Clarke, J. S., 1223
Coghlan, C. A., 1202
Crowley, J. A., Jr., 1202
Crits, J. S., 1137

Danforth, J. D., 1202
Darley, H. C. H., 1160
David, H., 1151
Davis, O. L., 1202
Deegan, C. J., 1135
Dons, E. M., 1202
Dwyer, T. H., 1165

Eilerts, C. K., 1162, 1163
Elliott, J. S., 1202
Engelke, B. F., 1202
Ess, P. R. van, 1202
Eudean, H. J., 1164
Evans, E. A., 1202
Evans, H. C., 1202
Ewing, F. J., 1202

Exline, P. G., 1164

Fairweather, H. G. C., 1202
Farkas, A., 1202
Flett, M. St. C., 1207
Flon, J. G., De, 1177
Forbes, R. T., 1185
Fuller, E. W., 1202

Gallia, R., 1202
Giammaria, J. J., 1202
Griffin, J. R., Jr., 1202
Guyot, R., 1220

Haensel, C., 1202
Hagen, O., 1138
Harris, S., 1158
Hepp, H. J., 1202
Hessels, W. J., 1203
Hickinbottom, W. J., 1188
Hill, F. C., 1202
Holt, P. H., 1202
Hull, C. M., 1202
Hutchinson, A. J. L., 1202
Hyde, J. F., 1202

Ipatieff, V. N., 1202
Irwin, J. L., 1171

Jenkins, V. N., 1202
Jenny, W. P., 1156
Johnson, J. H., 1133
Jones, P. J., 1166, 1167, 1168
Jones, W. J., 1206

Katan, L. L., 1200
Kejla, 1193
Kelso, C. D., 1202
Kelso, G., 1187
Kimball, T. B., 1202

Lancashire, R. P., 1199
Legatski, H. R., 1202
Lewis, J. A., 1201.
Leyland Cole, L. W., 1218
Lieber, B., 1202
Linn, C. B., 1202
Lonkomsky, S. A., 1202
Lowenstein-Lom, 1193
Luten, D. B., Jr., 1202

MacCracken, C., 1215
Marukjan, G. M., 1190
Marukjan, E. M., 1191
Mason, B. B., 1202
Mauro, O. G., 1202
Meinert, B. N., 1202
Mercier, V. J., 1157
Meyer, A., 1225
Monnot, G., 1220
Montgomery, C. W., 1202
Morgan, J. D., 1202

Neilson, R. B., 1226
Nelson, W. L., 1179, 1180, 1196
Neubauer, R. T. P., 1178
Nevagljadov, V. G., 1205
Newton, B. P., 1202
Nixon, A. C., 1202
Noll, H. D., 1187

Odell, W. W., 1202
Owen, J., 1202

Parker, J. S., 1213
Parquet, M. du., 1220
Partridge, W. A., 1202
Payne, G. L., 1202
Payne, J. W., 1202
Peiry, T. A., 1202
Pickett, A. D., 1202
Pines, H., 1202
Pont, du H. I., 1202
Prettre, M., 1195

Quarendon, R., 1211

Rostler, F. S., 1202
Ruthruff, R. P., 1202

Sack, H. A., 1209
Schmerling, L., 1202
Schmitkins, G. E., 1202
Schnabel, 1193
Serruys, M., 1224
Sheppard, N., 1208
Simpson, T. P., 1202
Smith, M. A., 1202
Smith, W. M., 1202
Sowerwine, E. O., Jr., 1202
Standing, M. B., 1197
Steenis, J. Van., 1203
Sterne, W. P., 1139
Stock, C. R., 1202
Stockman, L. P., 1235
Strang, L. C., 1202
Street, F. A., 1161
Stribley, A. F., Jr., 1202
Stuart, A. H., 1210
Sutherland, G. B. B. M., 1208

Thiele, E. W., 1202
Thomas, C. L., 1202
Thompson, H. W., 1207
Thornton, E., 1201
Trillat, J. J., 1209
Tuttle, R. B., 1181

Vago, E. B., 1207
Vallaud, A., 1198
Vichnievsky, R., 1220

Walters, E. L., 1202
Wasson, J. L., 1202
Waterman, H. I., 1203
Watson, E. A., 1223
Webb, G. M., 1202
White, C. C., 1155
Williams, C. G., 1214
Williams, R. H., 1202
Wilson, V. M., 1202
Wolf, A., 1216
Wood, W. H., 1192
Wood-Mallock, J. C., 1202

Yabroff, D. L., 1202
Young, D. W., 1202

Zaba, J., 1159
Zwilling, J. P., 1204

Oilfield Exploration and Exploitation.

Geology.

1133. Palæontology and its Relation to Petroleum Geology. J. H. Johnson. *Oil Wkly*, 16.12.46, **124** (3), 36.—Palæontology provides widespread correlation of sedimentary rocks. In making such correlation stratigraphic, ecologic, and palæontological considerations are involved, for assemblages vary with environment as well as with time.

Studies of modern conditions and organisms enable the palæontologist to reconstruct former conditions.

Disconformities may be revealed by palæontological work.

Palæontology will be of great value in the discovery of stratigraphic traps.

G. D. H.

1134. Geological Group Develops Columnar Section of pre-Permian Formations Along Central Basin Platform. J. M. Barton. *Oil Gas J.*, 14.12.46, **45** (32), 106.—It is maintained that the rocks of the basement complex may be Middle or Lower Cambrian as well as pre-Cambrian, since the oldest fossiliferous beds are Upper Cambrian. The basement includes basic igneous rocks, metamorphosed sediments, and granite. Above the " Cambrian " sandstone, which may occur only in depressions on the pre-Cambrian surface, are the Ellenburger sandy dolomite and dolomitic sandstone. As used here the term may include some Cambrian and Ordovician. The Simpson group consists of the Joins, Oil Creek, McLish, Tulip Creek, and Bromide in ascending order. Then follows the Montoya limestone and chert. The Hunton group is of Silurian and Devonian age, being divided into Lower, Middle, and Upper Hunton. The position of the top of the Silurian is uncertain in this shale and limestone series. It is not known whether the Woodford shale is Devonian or Mississippian. The succeeding limestone is called the Mississippian limestone, although the age is uncertain. Pennsylvanian beds are present.

A columnar section is included. G. D. H.

1135. Pratt Sees Great Oil Potentialities on Continental Shelf Slope. C. J. Deegan. *Oil Gas J.*, 7.12.46, **45** (31), 62.—Pratt defined the continental shelf as being bounded by water over 600 ft deep. This also marks the outer limit of effective wave and current action on the sea-floor, and the maximum depth to which sunlight is able to penetrate. The continental edges are a great shelving marginal plain comprising about 10% of the earth's surface, the outer half being covered by the seas. Below the dry land half are the oil reservoirs which have provided the bulk of the oil produced, and which hold a large proportion of the proved reserves.

About 15,000,000 square miles of the land area is underlain by a favourable section for oil formation and accumulation. The average thickness is 1¼ mile, giving 20,000,000 cubic miles of potential oil-bearing sediments on dry land. The continental shelf and slope down to 3000 ft sub-sea level cover 17,000,000 square miles, and the average thickness of these potentially oil-bearing sediments is such that the total volume of favourable underwater sediments is 50,000,000–55,000,000 cubic miles. G. D. H.

1136. Antilles Brings in New Pitch Lake Producer. Anon. *Oil Gas J.*, 14.12.46, **45** (32), 57.—A producer has recently been completed in the Tank Farm area north of the Brighton Field. The potential is 743 brl/day, and oil is obtained from the Nariva sand which has given six other wells at depths of 2600–2700 ft. G. D. H.

1137. Highlights of Gulf Coast Development. J. S. Critz. *Oil Wkly*, 16.9.46, **123** (3), 81.—The Gulf Coast has given 3,169,562,000 brl of oil, 2,082,236,000 brl having come from the Upper Texas Coast region.

The present daily output is 808,900 brl, of which the Upper Texas Coast provides 514,400 brl. The reserves are believed to total 4,395,000,000 brl. There are 396 oil, gas, and distillate fields; five have produced over 100,000,000 brl each, and seventy-four have accounted for 81% of the cumulative production.

Producing formations range in age from Eocene to possible Plio-Pleistocene. The deepest production is 13,778 ft. .

Subsequent to 1924 geophysics has played a part in Gulf Coast oil discoveries. It is estimated that 67% of the fields have been discovered by geophysics, and 12% by surface geology.

The principal producing zones are the Wilcox and Cockfield–Yegua (Eocene), the Marginula–Frio (Oligocene) and the Miocene.

Miocene sediments are 15,000–18,000 ft thick in South Louisiana.

There is a general monocline. Salt domes are numerous, and the top of the salt has been encountered at depths down to 12,608 ft. There are also stratigraphic traps, and faulted low relief anticlines.

A map shows the site of the largest Gulf Coast fields, and tables list the reserves and cumulative production of the largest fields, the producing horizons, the method of discovery of the fields, and their present status. G. D. H.

1138. Development Trends in Salt Dome Exploration. C. Hagen and R. Cantrell. *Oil Wkly*, 16.9.46, **123** (3), 87.—In the past five years some 340 million brl of oil have been added by salt dome development in the Gulf Coast. Vicksburg and basal Frio (Hackberry) production are probably new developments. Very young shallow sands are productive at Bayou Blue and Golden Meadows. Thick producing sands have been found at Weeks Island and Belle Isle.

Geophysics has proved of value in determining the lateral form of the domes. Some domes have proved to be irregular and ridge-like, and may have flank fault blocks. Electric logs and palæontology have revealed unconformities, and radioactive logs have shown passed-over production.

There are indications that some large domes have governed sedimentation in their neighbourhood. G. D. H.

1139. Greater Seminole Revived by Many Small Pools. W. P. Sterne. *Oil Wkly*, 9.12.46, **124** (2), 42.—During the past eighteen months about 100 discoveries or field extensions have been made in the Greater Seminole area. The Seminole pool was opened in 1925, and gradually activity spread over five countries. The Wilcox was the objective, and many promising Pennsylvanian horizons were ignored. Output began to decline and then the area was thoroughly examined by seismic crews and geologists. Almost all the recent discoveries are fault or stratigraphic traps in the Pennsylvanian–Booch (2500 ft), Cromwell (3000 ft), Senora (2000 ft), Calvin (1500 ft), and Gilcrease (2700 ft) sands.

Some of the more important pools in which the new developments have occurred are listed, and the outstanding points are discussed. A map shows the most active pools. G. D. H.

1140. Geological Survey Completes New Structure Map for Rangely Field. N. W. Bass. *Oil Gas J.*, 30.11.46, **45** (30), 86.—The Rangely pool produces from fracture zones in the Mancos shale at 500–1700 ft, and extensively from the Weber sandstone at 5500–6500 ft. One well produces from the Shinarump conglomerate. Initial yields range about 100–1000 brl/day, and mainly 250–500 brl/day.

The Weber is in the form of a large anticline with a steep south-west flank. The oil–water contact is 950 ft below the crest of the structure. In the southeast there are three normal faults, possibly trending northeast to southwest. The Weber sandstone is about 1200 ft thick, and includes some red shale beds, especially in the lower part. The oil-bearing horizons are in the upper 700 ft. Some of them are cross-bedded. The average porosity of the cored section is 8·9%, and the permeability 3·8 mD. However, some zones have a porosity of 20% and a permeability of 50 mD. There are prospective oil horizons below the Weber.

A stratum contour map of the Weber is given. G. D. H.

1141. Fourth Springhill Test is Located; No. 3 has High Gas–Oil Ratio Yield. Anon. *Oil Wkly*, 18.11.46, **123** (12), 15.—Springhill 3 was about 100 ft structurally higher than the discovery well, and has much gas with little oil. The latter has increased and may be 500 brl/day. A fourth test 1500 ft east of No. 3 has reached 3500 ft.

The producing horizon is now known to be of Cretaceous age. G. D. H.

1142. Umiat 1 Halts, May Quit. Anon. *Oil Wkly*, 18.11.46, **123** (12), 15.—Unofficially it is reported that Umiat 1 on Naval Petroleum Reserve No. 4 in Alaska will probably be abandoned at a little below 6000 ft. It has encountered at least five very tight sands with showings of oil or gas. The well is believed to be structurally low. G. D. H.

1143. Wildcatting Up Sharply. Anon. *Oil Wkly*, 28.10.46, **123** (9), 59.—428 exploratory wells were completed in U.S.A. in September 1946, and ninety-two were producers. During the first nine months 3446 exploratory wells were drilled and 689 were producers.

Tables summarize the results of exploratory drilling in U.S.A. in September and during the first nine months of 1946, according to States and districts. The September discoveries are listed with mention of salient points. G. D. H.

1144. October Wildcatting Sets High for Year. Anon. *Oil Wkly*, 25.11.46, **123** (13), 57.—480 exploratory tests were completed in U.S.A. in October, bringing the 1946 total to 3936. Eighty-two of the October tests were producers, while 771 of the tests during the first ten months were successful. The latter figure includes ninety-nine new gas pools and 158 distillate discoveries.

Tables summarize by States and districts, the results of exploratory drilling during October and the first ten months of 1946, and the October discoveries, are listed with data on salient points. G. D. H.

1145. Colombian Gulf Company's Test Reports Slight Show. Anon. *Oil Wkly*, 9.12.46, **124** (2), 31.—Sardinata 1 in the Middle Magdelena Valley has reached a depth of 7200 ft, and has found light oil shows in clayey, low-porosity sands from 6800 ft downwards. Impregnation is spotted. G. D. H.

1146. Wildcat in North Colombia may be Shallow Producer. Anon. *Oil Wkly*, 25.11.46, **123** (13), 29.—Tubara 1 in extreme northern Colombia has reached 5200 ft. In the section shallower than 3500 ft there are sands and sandy shale with few shale breaks, and these beds carry sufficient showings of oil and gas to indicate that a shallow producer is possible. G. D. H.

1147. Pemex Continues Hope for Big Oil Discoveries Despite Recent Failures. Anon. *Oil Wkly*, 11.11.46, **123** (11), 48.—Recently Tepezintla 1, 8 miles west of Cerro Azul, was abandoned at 6217 ft. Other tests have been drilled west of the Golden Lane, and in 1945 a well 10 miles west of Alama gave some oil. In the Castillo area mid-way between Soledad and Poza Rica two wildcats have been abandoned below 700 ft, showings being found in the Tamabra.

Las Norias 1 is being drilled on a structure southwest of the Mision field. Sarlat 23 on the Isthmus had a serious blow-out at 2454 ft. This wildcat is on a faulted structure. G. D. H.

1148. Texas Petroleum Company Test Opens First Field in Upper Magdalena Area. Anon. *Oil Wkly*, 9.12.46, **124** (2), 31; *Oil Gas J.*, 21.12.46, **45** (33), 47.—Velasquez 1 has been completed through casing perforations between 6900 and 7100 ft and is estimated to have a potential of 300–400 brl/day on a ½-in choke. The G.O.R. in early tests was 400–600 cu. ft./brl. The oil is 27·2°. A test of 7265–7275 ft gave only 25 brl/day of 26° oil. Untested but favourable sands occur at 6300 ft and 6700 ft. The Tertiary was found to rest on the basement at about 8500 ft. Velasquez 2 is to be drilled 2275 ft to the south.

Tablon 1 is being drilled in the Department of Bolivar east of Monteria.

G. D. H.

1149. Progress Made on Two New Colombian Wells. Anon. *Oil Gas J.*, 7.12.46, **45** (31), 64.—In the eleventh test 1 Velasquez has given a good oil show with a very small amount of gas. G. D. H.

1150. Atlantic Brings in New Venezuelan Producer. Anon. *Oil Gas J.*, 14.32.46, **45** (32), 57; *Oil Wkly*, 16.12.46, **124** (3), 29.—A well has been completed on the Pelayo concession in Anzoategui. A potential of 425 brl/day of 30·5° oil is indicated. Seven horizons have been tested. The total depth was 7488 ft. G. D. H.

1151. Central European Nations Depending on Oil to Finance Post-War Rehabilitation. H. David. *Oil Gas J.*, 30.11.46, **45** (30), 44.—Production in Austria and Hungary has risen sufficiently so that with Roumania's reduced output there is enough oil to supply those three countries, Italy, Greece, Yugoslavia, and Czechoslovakia. The fields are on the outer edge of the Carpathian arc. 98% of Roumania's output has come from an area 45 miles by 15 miles. Production is from Pliocene beds associated with faults, folds, and salt intrusions. Dacic production is spotted, but can be rich. A little oil is obtained in eastern Roumania from older beds on complex structures. The Upper Miocene yields dry gas on seven domes in the Transylvanian basin. Roumania's current output is about 100,000 brl/day.

In Hungary Budafapuszta and Lovaszi produce from the Pliocene, and each may have reserves in excess of 25,000,000 brl. Hahot produces from a Triassic dolomitic limestone. The first two fields are on anticlines, and Hahot is on a buried ridge. All are in a small Pliocene basin possibly connected with the large Pannonian basin to the east in which there has been wildcatting, giving north and west of Arad gas and condensate at Totkomlos and Korossegapati. The area has a thick Quaternary cover which masks structures.

Since 1913 Bitkow, a small field, is the only new field opened in Poland.

The Austrian output rose to 5000 brl/day in 1942. Oil occurs in the Eocene and Miocene of the Vienna basin along a faulted ridge. Accumulation seems to be related to fracture zones within a few hundred feet of the fault. G. D. H.

1152. Gas Producer near Vienna. Anon. *Oil Wkly*, 16.12.46, **124** (3), 29.—A 1,412,000 cu. ft./day gas well has been completed near Vienna. G. D. H.

1153. Hungary Reports Oil Find. Anon. *Oil Gas J.*, 14.12.46, **45** (32), 58.—The presence of oil in the Danube–Tiza basin, about 70 miles southeast of Budapest, has been reported. G. D. H.

1154. Gas Well in Poland. Anon. *Oil Wkly*, 16.12.46, **124** (3), 29.—Dembowiec 1, near Skoczow in extreme western Poland, flowed 3530 cu. ft. of gas/minute from a depth of 1300 ft. G. D. H.

Geophysics and Geochemical Prospecting.

1155. Electrical Logging : a Study of the Self-Potential Curve. C. C. White. *Oil Gas J.*, 14.12.46, **45** (32), 88.—The self-potential in electric logging is made up of the electro-chemical and electro-filtration potentials. The former is set up at the contact of two waters of different salinities, the formation and drilling mud waters. If the drilling mud has the lower salinity the potential is negative. The streaming potential is a function of the pressure differential, permeability, fluid viscosity, and resistivity. Mudding-off will affect the permeability.

Analysis of data from the South Albion field of Illinois indicates that in the Waltersburg sand 100 mV may be due to electro-chemical effects, and 29 mV to electro-filtration.

The amount of potential shown on the electric log is dependent on the tendency of the mud and the surrounding formations to carry it away, and also on the strength of the source of potential. There may be a small electro-chemical potential opposite shales, but electro-filtration potentials can be developed only where there is permeability.

It is suggested that the presence of high resistivities in itself does not cause diminution of self-potential. G. D. H.

1156. Structural Correlation of Micromagnetic and Reflection Data. W. P. Jenny. *Oil Wkly*, 16.12.46, **124** (3), 32.—Large domes may govern sedimentation in their vicinity, and this may be true in a more limited fashion with small domes. Hence there may be difficulty in correlating reflections over local structure.

Certain beds are sufficiently magnetized to serve as key-beds in micromagnetic surveys. These may be above, below, or the same as the reflecting beds.

A series of hypothetical cases are described in which magnetic data permit the

resolution of structural features which cannot be ascertained by reflection data because the magnetic formation is more complete than the reflecting horizon. G. D. H.

1157. Radioactivity Well Logs Interpretation and Application. V. J. Mercier. *Oil Wkly*, 14.9.46, **123** (7), 56.—Laboratory work has shown that among sediments limestones, sandstones, and dolomites are generally very low in radioactivity, while black and marine shales are high in radioactivity. A knowledge of local lithology is necessary, because sandstone, limestone, and dolomite cannot be distinguished on radioactive well logs by the logs alone. At times these rocks also are high in radioactivity. Accurate formation thickness measurements are possible from the logs, picks being made at the mid-points of transitions on the curves. Correlation is possible by means of these logs; cased-off formations and carnotite squeeze cement can be detected, and logging is possible in fluids which prevent the making of ordinary electric logs.

The neutron curves are obtained when the strata undergo neutron bombardment, and may be considered as "fluid content or hydrogen curves," since the amount of hydrogen greatly influences the curves. The instrument is made insensitive to natural gamma rays. Combined with the gamma-ray curve the neutron curve is valuable for detailed studies. The neutron curve, due to differences of instrument design, gives better definition of thin beds than does the gamma-ray log. It is excellent for locating porous horizons in beds. Shales contain hydrogen in connate water and in minerals.

An example of the interpretation of neutron and gamma-ray logs is given.

G. D. H.

1158. West Texas Modern Refraction Seismic Exploration. S. Harris. *Oil Wkly*, 14.10.46, **123** (7), 52.—Modern refraction technique has recently led to several oil discoveries in the Edwards Plateau area. Generally, the reflection method has not given satisfactory results in this area, due apparently to the presence of a thick layer of Edwards limestone at the surface. In the Permian Basin there are local areas where caliche interferes with clear recording of reflections.

The new refraction technique is not solely dependent on first arrivals, and gives greater penetration with less dynamite. The seismometers are spread, and correlation by character is used. The accuracy is, however, not so great as with reflection work, but changes in elevation of the refracting surface can be computed.

The cost of an average seismic refraction crew in the Edwards Plateau area is about $25,000 per month. In reconnaissance work about fifty sections can be covered each month; in detail control in rough terrain the output may be only ten to twelve per month.

In the Edwards Plateau area refractions as deep as the Ellenburger have been obtained. At pre-Permian levels closures of 200 ft are detectable, and in the Permian 100 ft. G. D. H.

Drilling.

1159. Modern Rotary Drilling. Parts 11–20. J. Zaba. *Oil Gas J.*, 15.3.47, **45** (45), 99; 22.3.47, **45** (46), 291; 29.3.47, **45** (47), 175; 5.4.47, **45** (48), 103; 12.4.47, **45** (49), 99; 19.4.47, **45** (50), 133; 26.4.47, **45** (51), 181; 3.5.47, **45** (52), 105; 10.5.47, **46** (1), 97; 17.5.47, **46** (2), 111.—These papers are a continuation of the series of brief articles on trends and developments in modern drilling practice. The sub-titles of parts 11–20 are as follows: (11) Portable Drilling Masts; (12) Erection and Dismantling of Portable Drilling Masts; (13) Load and Speed Conditions of the Hoisting Cycle; (14) Effect of Engine Characteristics; (15) Draw-Works—General; (16) Draw-Works—Auxiliary Brakes; (17) Auxiliary Draw-Works Brake—Hydraulic Type; (18) Capacities and Modern Arrangements of Hydraulic Type Draw-Works Brakes; (19) Electromagnetic Draw-Works Brakes; and (20) Draw-Works Clutch System.

R. B. S.

1160. The Application of the Principles of Clay Chemistry to Problems Encountered When Drilling in Trinidad Clays. H. C. H. Darley. *J. Inst. Petrol.*, 1947, **33**, 219.—Such properties of clays as affect drilling problems are discussed. It is shown that with clay-base muds, in order to maintain the characteristics necessary for drilling a high degree of dispersion of the clay particles is required, but that the dispersion agents

'react on the bit cuttings and formation to cause rapid rises in viscosity, "sticky" drilling with consequent low rates of penetration, and to promote caving. Attempts to mitigate these difficulties with clay-base muds are described. Alternatives to clay-base muds are discussed and the results of laboratory tests of starch muds containing flocculating agents are given. An account is given of the trial of a starch–aluminium sulphate drilling fluid, which gave a marked increase in the rate of penetration but developed excessive gel strengths. The properties of a starch–sodium chloride–sodium silicate drilling fluid, which appeared to offer a solution to the problems under discussion, are given. J. T.

Production.

1161. New Development in Producing Equipment. F. A. Street. *World Petrol.*, 1947, **18** (5), 76–77.—Engine design has been simplified and drilling equipment made more portable. Quality has been improved so that in certain fields drilling costs are down, in spite of a rise in wages. Light alloys and plastics are finding a more extensive use. Long-stroke pumping units are being developed, particularly for deep-well pumping. Work has been speeded by aids, such as a new device to prevent drill-pipe becoming stuck in key-seats when the pipe is being pulled, and a camera which will photograph the well bore, either continuously or at intervals. Television apparatus is being developed to give a view on the surface of the well bore. Radioactive markers and a gas meter which can be sunk and register the presence and extent of gas are in use. F. S. A.

1162. Gas-Condensate Reservoir Engineering. Part II. Fluid Properties and Flow Relationships in the Reservoir. C. K. Eilerts. *Oil Gas J.*, 8.2.47, **45** (40), 78.—In this part are discussed: (1) the recovery of hydrocarbon liquids associated with lean fluids in the reservoir, and (2) the recovery of rich gas-condensate fluids from reservoirs. Liquid precipitated in the reservoir from lean fluids will be held in the pores of the formation unless (*a*) it exceeds the residual liquid saturation in which case it will flow towards the producing wells with the gas, or (*b*) it is subsequently vaporized as the reservoir pressure declines: the possibilities of this occurring are remote. In the light of these facts the effects of fluid saturation and of the character of gas–liquid flow are further discussed.

The reservoir phase state of a rich fluid may be considerably different to that of a lean fluid owing to the fact that a rich fluid is more likely to exist in close proximity to the critical point. In this case, the properties of the separating gas and liquid phases have almost identical properties. The fact that the ratio of the viscosity of the gas phase to that of the liquid phase is almost unity leads to a somewhat anomalous behaviour, since the per cent liquid saturation of a sand required for flow of liquid (and thus the residual liquid saturation) is lowest when the gas and liquid phases are alike in properties. Ten references are appended. R. B. S.

1163. Gas Condensate Reservoir Engineering. Part III. Equilibrium Factors, Hydrates, and Corrosion. C. K. Eilerts. *Oil Gas J.*, 15.2.47, **45** (41), 100.—The following problems are explained: (1) the determination of equilibrium factors for use in the design of equipment employed in extracting specific hydrocarbons from gas-condensate fluids (2) the utilization and the development of data on natural gas hydrates to facilitate the operation of field collecting systems, gas pipelines and drying plants; and (3) the control of internal corrosion of flow strings, Christmas-tree fittings and collecting lines. Such corrosion is known to be serious in many gas-condensate fields. Sixteen references are appended.

This is the final part of a series of three papers which has included an excellent bibliography of a total of thirty-seven references. R. B. S.

1164. Apparatus for Analysis of Reservoir Fluids. P. G. Exline and H. J. Endean. *Oil Gas J.*, 15.3.47, **45** (45), 82. (*Paper presented at spring meeting, A.S.M.E., Tulsa.*)—A description is given of an apparatus designed to study the volumetric and viscosity behaviour of reservoir fluids. The complete pressure system can be described as being made up of three independent sections: (1) the analysis section in which both bottom-hole samples and recombined samples can be analysed—it consists of (*a*) a

variable volume cell in which the volumetric test measurements are made, (*b*) a rolling ball viscometer for viscosity measurements, and (*c*) a magnetic pump for circulating the fluids and maintaining equilibrium between the phases; (2) the gas compression system used for the quantitative injection of gas into the analysis section for recombination with the separator liquid in the correct proportion; and (3) the pressure-indicating system for indicating the pressure within either of the other two systems during a test. Each of these sections is described and the calibration of the apparatus and method of procedure are explained. Ten references are appended. R. B. S.

1165. Packer Problems in West Texas. T. H. Dwyer. *Oil Gas J.*, 5.4.47, **45** (48), 92. (*Abridged version of paper presented before S.-W. District Division of Production, A.P.I., Fort Worth*, March 1947.)—This paper forms a discussion of both casing packer problems and open-hole packer problems, each of which are treated under the following sub-headings: (1) problems readily solved with available packer equipment; (2) problems solved with some difficulty using available packer equipment; (3) problems apparently solvable by packers if improved equipment were available; and (4) recommended practice for running, setting, and removing packers. R. B. S.

1166. Oil Production by Water. Part 15. Control of Per Interval Producing Rates. P. J. Jones. *Oil Gas J.*, 1.3.47, **45** (43), 67.—The producing characteristics of the multiple-pay reservoir studied in Part 14 (the R-2 reservoir) are used to show that the control of per-interval producing rates is a significant factor in production. Several conditions are investigated and it appears that control of producing rates depends primarily on isolating the production from the various pay intervals. The different effects of dual completions and separate completions to each zone are discussed from an economic standpoint. R. B. S.

1167. Oil Production by Water. Part 16. A Linear Reservoir. P. J. Jones. *Oil Gas J.*, 8.3.47, **45** (44), 62.—A hypothetical stratigraphic type reservoir—called the L-1 reservoir—is considered, and its characteristics are mapped out in detail. Various diagrammatical and graphical methods of illustrating (1) the distribution of pay zones, (2) pay thicknesses, and (3) acres of oil–water interface, are shown, thus enabling a clear picture of the productive limits of the reservoir to be formed. The need for so much detailed mapping is to be explained in succeeding parts. R. B. S.

1168. Oil Production by Water. Part 17. One Producing Unit. P. J. Jones. *Oil Gas J.*, 29.3.47, **45** (47), 147.—The initial producing capacity of the L-1 reservoir described in Part 16 was only 7000 brl/day relative to one oil–water interface. This rate is too slow to be economical, but it can be increased by drilling a row of injection wells other than those required along the normal water–oil contact. Such a row of up-dip injection wells gives two additional oil–water interfaces and therefore splits the original reservoir into three producing units. The factors which have to be considered in splitting reservoirs are discussed and a hypothetical example is given. R. B. S.

Oilfield Development.

1169. Completions Total Tops 1945 Period. Anon. *Oil Wkly*, 28.10.46, **123** (9), 57.—In the first nine months of 1946, U.S. well completions totalled 21,910. The total for the same period of 1945 was 19,115 wells. This year's completions include 11,713 oil wells and 2071 gas wells. 1516 service wells were drilled.

A table lists the September 1946 completions by States and districts, and according to type. G. D. H.

1170. Completions for Year to Approach 30,000. Anon. *Oil Wkly*, 25.11.46, **123** (13), 63.—During the first ten months of 1946, 25,474 wells were completed in U.S.A. The October completions numbered 2756. 13,298 of this year's completions have given oil, 172 distillate, and 2632 gas.

The October and January–October completions are summarized by States and districts. G. D. H.

1171. Canadian Oilfield Development in 1946. J. L. Irwin. *Petrol. Times*, 24.5.47, **51**, 482.—The development of the Albertan Oilfields in Western Canada is briefly reviewed and figures are presented of production by fields for 1945 and 1946. The total Albertan production in 1946 was 7,137,693 brl as compared to 8,055,440 brl in 1945—a decrease of 917,747 brl. However, many new structures are being explored and the recent trend towards increased production experienced towards the end of 1946 is expected to persist into 1947. R. B. S.

1172. Argentina's Production for Six Months Declines. Anon. *Oil Wkly*, 11.11.46, **123** (11), 48.—In the first half of 1946 the State-owned fields produced 6,996,875 brl of oil and the privately owned fields 3,324,506 brl. The corresponding figures for the first half of 1945 were 7,779,909 and 3,771,536 brl respectively. G. D. H.

1173. Continued Decline Shown in German Oil Production. Anon. *Oil Wkly*, 16.12.46, **124** (3), 29.—In the first ten months of 1946 3,833,473 brl of oil was produced in the British zone of Germany. 71% came from the Hanover–Braunschweig area, 11% from Schleswig–Holstein, 10% from Westphalen, 6% from Luneburg, and 2% from Olderburg–Ostfriesland.

The output each month is given. G. D. H.

1174. Russians are Successful in Developing Tuimazy Field. Anon. *Oil Wkly*, 25.11.46, **123** (13), 29.—Development of the Tuimazy field was delayed by the war until 1944 when a well found good production in the Devonian at 6560 ft.

Of 12,000,000 brl of oil produced in Bashkiria in 1939, 218,000 brl came from Tuimazy. G. D. H.

1175. Large Reserves Claimed by Magazine for Russia. Anon. *Oil Wkly*, 25.11.46, **123** (13), 29.—According to an article by Ivanov and Poznanskaya Russia had oil reserves of 46,300,000,000 brl in 1937.

The 1940 production was 225,000,000 brl, and the output is planned to reach 257,000,000 brl/year in the current five-year plan, with an objective of 435,000,000 brl in 1965. G. D. H.

1176. Iran Production May Top 1945 Mark by Five Million. Anon. *Oil Wkly*, 16.12.46, **124** (3), 29.—In August 1946 Iran produced 11,689,500 brl of oil, giving an aggregate of 96,270,000 brl for 1946. G. D. H.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

1177. Cooling Tower Performance Evaluated for the Plant Operator. J. G. De Flon. *Pipe Line News*, April 1947, **19** (4), 15.—The factors necessary for consideration in designing cooling tower plant are discussed. The required tower size is a function of: (1) the cooling range (*i.e.* the hot water temperature minus the cold water temperature); (2) the approach to wet bulb temperature (*i.e.* the cold water temperature minus the wet bulb temperature); (3) the quantity of water to be cooled; (4) the wet bulb temperature; (5) the air velocity through the cell; and (6) the tower height. The design calculations can be simplified by the use of charts: the necessary charts are printed and their use is illustrated by several simple examples. Finally, cooling tower spray nozzles are very briefly discussed. R. B. S.

1178. Gas Turbine-Driven Centrifugal Compressors for Natural Gas Pipelines. E. T. P. Neubauer. *Oil Gas J.*, 3.5.47, **45** (52), 59.—The fundamental characteristics of the gas turbine as a source of power for natural-gas pipeline work are discussed.

The compression ratio and the characteristics of the gas being compressed determine the applicability of centrifugal plant.

Centrifugal compressors are adapted to automatic operation and until recently an economical prime mover has not been available. A large horse-power unit is required;

the electric motor is expensive to run, and the steam turbine presents difficulties particularly as regards water. The gas turbine, however, permits low maintenance and service costs, and can use gas from the pipeline as fuel.

Among other desirable characteristics of the gas turbine are its possession of rotating parts only, with speeds high enough to permit directly connected compressors; no necessity for water, and one unit, or at most two, could handle at each station a load of 250,000,000 cu. ft. gas per day. G. A. C.

1179. Reciprocating-Pump Data. Refiner's Notebook No. 143. W. L. Nelson. *Oil Gas J.*, 10.5.47, **46** (1), 99.—Data are presented in tabular form for the following types of pump: Triplex, Simplex, Boiler Simplex, Piston Duplex, and Plunger Duplex, sizes ranging from $1\frac{1}{2} \times 2$ in, to $12 \times 11 \times 12$ in, g.p.m. 2·75 to 756·0. Information includes rated working pressure (p.s.i.), pump speed (r.p.m.), piston speed (ft/min) discharge pressure, steam required at rated pressure (lb/hr) and approximate weight. W. M. H.

1180. Pumping Cost. W. L. Nelson. *Oil Gas J.*, 7.6.47, **46** (5), 103.—This No. 145 in the *Refiner's Notebook* series replaces No. 145 issued May 24, 1947, which is withdrawn. Hydraulic horse-power, brake horse-power, power cost per pumping month (U.S.A. dollars), pump efficiency in per cent, and water rate (lb per brake h.p.-hr) are related on one chart. G. A. C.

1181. Adequate Maintenance and Sound Operating Methods Assure Efficiency of Steam Power Plants. R. B. Tuttle. *Oil Gas J.*, 10.5.47, **46** (1), 72.—Case histories show that detailed records of performance, made and studied during the early life of a plant, may lead to increased efficiency and a cut in production costs. Many boiler plants suffer from inadequate instrumentation, and a plentiful supply of cheap fuel may also lead to inefficient running, particularly in gas-fired boilers. Automatic control of mixed-gas combustion is practicable, and will cut operating costs.

Two Mid-Continent refineries are cited as examples of efficient running. Each operates at an average overall efficiency of 75%, with average cost of steam production at \$0·1805 per 1000 lb, exclusive of depreciation. 5·66% of total production cost is made up of maintenance labour and material. Neither refinery has been forced to shut down for steam-generating plant repair for many years. Instrumentation is above average, for the provision of operating information. A summary of expense items is shown.

Efficiency of other plants in the same area varies greatly, but an average operating cost for nine of these is 11·3% higher than that of the two plants described; and in some the operating efficiency is as low as 55–65%, with a cost of \$0·2248 per 1000 lb, excluding depreciation. These plants possess no accessories for improvement of boiler efficiency, and instrumentation is so poor that no accurate production data are available, but operating conditions indicate that plant efficiencies could be increased if water treating procedures were improved. W. M. H.

1182. English Petrochemical Plant Taking Shape Near Manchester. Anon. *Oil Gas J.*, 7.6.47, **46** (5), 44.—An outline is given of the plants to be erected by Petrochemicals Ltd. at Partington, Manchester, England. The site has an area of about 800 acres, fifty of which are adjacent to the Manchester Ship Canal.

The Catarole process is to be used; a fraction of boiling range 225–500° F obtained by straight distillation is catalytically cracked in the gaseous phase with the production of olefinic gases and aromatics or polycyclic aromatics.

Prospective users of Catarole products may erect plant within the site; and steam, electricity, and water may be provided from a central plant.

Construction has already commenced. Primary plant will consist of five cracking furnaces, gas purification plant, gas separation, and distillation units.

The olefinic gases, such as ethylene and butadiene, will be separated and obtained in great purity through compression, refrigeration, and fractional distillation processes in the secondary plant.

Throughput is planned at 50,000 tons/annum, but plant design is such that this may be increased to about 120,000 tons/annum. G. A. C.

1183. New Plants for the N.V. de Bataafsche Petroleum Maatschappij in Holland. Anon. *De Ingenieur*, 6.6.47, (23), 205–209.—A brief review of two new plants and one enlarged plant is given together with schematic diagrams of the two new plants :—

(1) A plant to increase the production of fixed nitrogen from air from 16,000 tons/annum to 51,000 tons/annum.

(2) A plant for the production of a synthetic detergent from cracked paraffins. The rated capacity is 25,000 tons/annum and should be in production by the end of 1948.

(3) A plant for the production of P.V.C. plastics of rated capacity of 2000 tons/annum. N. C.

Distillation.

1184. Calculation of Distillation Columns Having no Side-Stream. V. Chibaeff. *Rev. Inst. Franç. Pétrole*, 1947, **2**, 25–37, 99–107.—A study of continuous columns yielding overhead and residue products only. The method of calculation is based on the relative volatility of the two main components of the feed and enables a rapid calculation to be made of the theoretical number of concentration and stripping plates needed to give a distillate and residue of required composition at a determined reflux ratio. The method avoids successive equilibrium calculations for each plate by introducing a term for minimum reflux ratio into the calculation. The calculation is described in detail and a method for a graphical solution is also given. A knowledge of the relative volatilities of the components to be distilled is essential. V. B.

1185. Twenty Centuries of Distillation. R. T. Forbes. *De Ingenieur*, 13.6.47, (24), M.15–21.—The process of distillation is traced from the earliest known procedure, the Coptic method, to the patenting of the Heckmann column. The article is well illustrated with photographs of early apparatus. N. C.

Cracking.

1186. Factors Affecting Yields in Thermal Cracking of Residue Oils to Liquid Residues. G. Armistead, Jr. *Oil Gas J.*, 17.5.47, **46** (2), 103.—The most important factors affecting yields in thermal cracking are viscosity breaking, gravity of feed and fuel oil, cracked gas oil withdrawn, and gasoline end-point produced.

Viscosity breaking reduces viscosity of heavy stocks and lowers the boiling range and pour-point. Its effect on gas-oil production and viscosity of residue is shown in graphical form. Operations are designed to produce lowest viscosity fuel oil with the minimum sacrifice in gasoline yield. Heavy tars may be cut back with lighter cracking-stock fractions.

The effect of process characteristics and operating conditions varies greatly, and must be evaluated for every specific process, though it may be said generally that processes involving gas-oil cracking above 1050° give low gasoline yields, and that gasoline yields are increased by selectivity and by viscosity breaking.

Gasoline yield is correlated with ° A.P.I. of feed and fuel oil in a series of curves.

Withdrawal of gas oil reduces gasoline and fuel oil yields by the amount obtainable from the cracking of such withdrawn quantities. This is illustrated by a table showing potential gasoline yields related to properties of gas oil withdrawn.

The effect of cracked-gasoline end-point charge on gasoline and fuel oil yield follows a linear relationship, and, for gasoline, is about 3% volume. Charge on basis of gasoline yield for each 10° charge above and below 400° end-point.

Six references are given. W. M. H.

1187. Effect of Temperature in Thermofor Catalytic Cracking. H. D. Noll, R. E. Bland, and G. Kelso. *Oil Gas J.*, 10.5.47, **46** (1), 64.—Data are presented for effect of reaction temperature on yields and octane ratings, A.S.T.M. and Research, of gasoline produced in once-through T.C.C. cracking of East Texas heavy gas oil. An economic analysis is included, since highest octane numbers do not correspond with highest gasoline yield.

Stock was processed in single-pass operations over synthetic bead catalyst, with reactor temperatures of 775° to 960° F and conversions of 40–70% by volume. Basic

data, such as characteristics of stock, operating data, yields, octane numbers, and earnings, are expressed in a series of curves and tables.

An increase in the average reactor temperature results in increase in (*a*) yield of propylene and butylene, (*b*) yield of dry-gas, (*c*) octane number measured by both A.S.T.M. and Research methods, though the gain in the A.S.T.M. value is lost or minimized on adding T.E.L.

An increase in temperature leads to a decrease in (*a*) gasoline yield; (*b*) C_{4+} liquid recovery. W. H. M.

Isomerization.

1188. Autoxidation of Olefins: Formation of Unsaturated Alcohols from Olefins by the Action of Organic Peracids. W. J. Hickinbottom. *Nature*, 1947, **159**, 844.—The unsaturated alcohols obtained by the reaction of peracetic acid with *a*- and *β*-diisobutylenes is formed from the isomerization of the epoxide which is an intermediate in the reaction. Thus 2 : 4 : 4-trimethylpentan-2 : 3-epoxide and acetic acid, with a trace of sulphuric acid, gives 2 : 4 : 4-trimethylpenten-1-ol-3 (I), the monoacetate of 2 : 4 : 4-trimethylpentan-2 : 3-diol (II), and a substituted dioxane (III). The yield of I and II is approximately the same, and that of III rather less.

These experiments substantiate the hypothesis that the preliminary phase of the peroxidation of olefins by oxygen is the formation of a moloxide (similar in structure to the epoxide) followed by hydroperoxide formation due to the opening of the moloxide ring and change in position of the double bond. The opening of the ring system may be accompanied by the formation of bimolecular oxygenated and carbonyl compounds. H. C. E.

1189. Converted U.O.P. Isomerization Unit Now Makes Polymer Gasoline. L. C. Brown. *Oil Gas J.*, 17.5.47, **46** (2), 91.—Co-operative Refinery Association at Coffeyville, Kans., have converted their butane isomerization unit to a U.O.P. polymerization plant producing 150 brl, of high-grade motor gasoline daily. Cost of conversion was $18,000, time taken being three weeks.

The polymer gasoline has an A.S.T.M. clear octane rating of 82, Research clear octane rating of 95, and R.V.P. 10 lb.

Hot oil from the thermal cracking unit is used to preheat the combined poly feed and to supply heat to the depropanizer reboiler, the feed being obtained as liquid from the cracked gasoline stabilizer. The aluminium chloride saturates are used as caustic- and water-wash columns for pretreatment, and the hydrogen chloride recovery column has become a surge column for handling combined recycle and fresh feed. The isomerization reactor was adapted in installing in the column two catalyst beds filled with solid phosphoric acid catalyst over crushed fire brick. The combined feed is discharged above the first bed, and a distribution ring between the two beds brings about rapid mixing of quench and first bed effluent. The alkylation motor-driven gland-seal pump is used to pump the charge, and the aluminium chloride column now serves as gasoline stabilizer.

Flow through the plant is described, and a flow-sheet included, together with tables of yields and properties. Production of gasoline to date has been 117 gal per lb of catalyst, and catalyst life will probably approach 150 gal, a result of very complete instrumentation and recognition of reactant variables. W. M. H.

1190. Dehydrogenation of Aliphatic-Cyclic Hydrocarbons to Substances Capable of Polymerization, and the Laws Governing these Reactions. A. A. Balandin and G. M. Marukjan. *Compt. Rend.* (*Doklady*) *Acad. Sci. URSS.*, 1947, **55**, 121 (in English).—Several previous papers by the authors on the preparation of arylolefins from aliphatic-cyclic hydrocarbons by catalytic dehydrogenation over a copper–chromium catalyst at 625° C are reviewed. The yields obtained for a single pass at a liquid feed rate of 450 ml/litre/hr are compared with the yield of styrene from ethylbenzene as a standard, and reduced to a fixed catalyst activity. Yield data are given for thirteen hydrocarbons, including ethane, cumene, *sec.*-butylbenzene, *o*-, *m*-, *p*-diethylbenzenes, *p*-di-*iso*propylbenzene, *p*-di*sec.*butylbenzene, 1 : 1-diphenylethane, 1 : 2-diphenylethane, and tetralin. The results are used to deduce four rules governing the effect of structural changes on the ease of dehydrogenation of alkylbenzenes and aryl-substituted ethanes. G. H. B.

1191. Comparative Velocity of the Catalytic Dehydrogenation of Monoalkylbenzenes and Dialkylbenzenes. A. A. Balandin and E. M. Marukjan. *Compt. Rend.* (*Doklady*) *Acad. Sci. URSS*, 1947, **55**, 215 (in English).—The authors had previously shown that mono- and dialkyl-benzenes were dehydrogenated at the same rate over a copper–chromium catalyst at 625° C and the subject has been examined in greater detail. With a freshly regenerated catalyst the dehydrogenation rate was actually greater for ethylbenzene than for *p*-diethylbenzene, but the difference rapidly disappeared as the catalyst deteriorated. A similar effect was found in progressive experiments with *iso*propylbenzene and *p*-di*iso*propylbenzene passed alternatively over a single batch of catalyst. Analysis of the reaction products from diethylbenzene showed that both ethyl groups were dehydrogenated simultaneously to divinylbenzene, and that *p*-ethylstyrene was not formed as an intermediate product. The dehydrogenation rates were also equal for mono- and dialkyl-benzenes at other temperatures indicating that both types of compound have practically equal activation energies of dehydrogenation. An explanation is advanced for the experimental findings, based on the view that on the particular catalyst used, the alkyl groups of both mono- and dialkyl-benzenes are suitably disposed about the centre of adsorption to dehydrogenate independently at equal rates. G. H. B.

Chemical and Physical Refining.

1192. Catalytic Desulphurization of Cracked and Straight-run-Gasolines. R. C. Amero and W. H. Wood. *Oil Gas J.*, 24.5.47, **46** (3), 82.—The relative merits of clays and bauxites as desulphurization catalysts for various types of cracked gasolines are investigated and discussed.

The investigation was carried out in three steps: (1) a space velocity–temperature study to determine optimum operating conditions; (2) runs on a cracked gasoline to determine the relative catalytic activities of clays and bauxites; and (3) a study of the catalytic effect of fuller's earth and bauxite on several cracked and straight-run gasolines.

No general conclusions regarding the relative efficiency of fuller's earth and bauxite as desulphurization catalysts could be arrived at as results are influenced by the nature of the stock.

Maximum yields of mercaptan-free gasoline were obtained with operating conditions of a space velocity of one—one volume of liquid charge per hour—and temperature of 750° F, these processes permitting of elimination of the sweetening step.

With 3 ml of T.E.L. octane ratings were raised up to 12 or higher for research ratings, estimates of 6–15 cents per brl of gasoline are reached; a saving in T.E.L. of 15 cents per brl shows a net gain of 7·5 cents on the complete process.

Six figures and four tables illustrate the article. G. A. C.

1193. The Phenosolvan Process. Lowenstein-Lom, Schnabel, and Kejla. *Petroleum*, April 1947, **10**, 82.—In 1939 and subsequently during the war, German scientists developed a method for extracting phenols from gasworks ammoniacal liquor and other sources by the use of aliphatic esters as extracting agents. The use of a mixture of esters consisting mainly of butyl acetate proved satisfactory and a pilot plant and three full-scale extraction plants were erected during the war for this process.

The possibility of alternative solvents to butyl acetate was investigated by the authors especially in view of the unsatisfactory supply situation for this material.

The main industrial processes for phenol recovery include extraction with benzol or other hydrocarbon solvents, combined with a caustic wash of the saturated solvent, sodium phosphate extraction followed by solvent recovery by distillation of the phenolic extract, and Kopper's recirculated steam distillation.

Where the solvent is actually produced on the plant or in gasworks and coke plants, hydrocarbon extraction is usually given preference. Difficulties are met with in coal hydrogenation plants because their phenolic liquors contain large quantities of alkali-soluble non-phenolic substances (fatty acids) and polyhydric phenols.

The phenosolvan process differs from other methods mainly in that (1) the solvent has a lower boiling point than the extracted phenols, (2) a mixture of phenols is obtained by simple distillation of the solvent and not by chemical treatment, (3) solvent is recovered from extracted liquors by evaporation and from the phenolic extract by distillation.

The properties of the solvent are dictated by the unit processes of which the extraction is made up. To reduce loss of extracting agent to a minimum the solvent should be a little soluble in water. At the boiling point of the mixture solubility should be almost zero. The solvent should not react chemically with the substances present in phenolic liquors. In this connection esters are easily saponified and butyl acetate cannot be used if free ammonia exceeds 3 g/litre in the liquor.

As many solvents form azeotropes with water, the proportion of solvent in the azeotrope should be as high as possible, the latent heat and boiling point of the pure solvent should be low. Flash-point should be high and toxicity low. A high distribution ratio—concentration of phenol in the solvent to concentration in the extracted liquor at equilibrium—is required.

Theoretically, the ideal solvent would be polar, possess a high dielectric constant, and be non-ionising. Halogenated solvents are unsuitable because of their unfavourable distribution coefficients. A sulphur atom generally unduly raises the boiling point.

Experimental work is described to assess the possibilities of the use in the extraction process of numbers of alcohols, esters, ketones, and ethers.

Their physical properties relevant to the discussion are tabulated.

It is concluded that certain compounds, as, for example, methyl butyl ketone, methyl *iso*-butyl ketone, dibutyl ether, di*iso*propyl ether, and the butyl and amyl acetates can all be used. F. W. H. M.

Special Processes.

1194. Total Gasification of Fuels by the Koppers Process. J. Barral. *Chim. et Ind.*, 1947, **57**, 441–443.—The Koppers process is designed to convert low-grade solid fuels (*e.g.* lignite) into a synthesis gas suitable as feed to a Fischer–Tropsch plant. A simplified flow diagram of the process is given, as well as analysis of the fuel, gas, and of the costs involved. The process is applicable to fuels having an ash content as high as 20%. V. B.

1195. Methane. A Reagent for Hydrocarbon Synthesis. M. Prettre. *Rev. Inst. Franç. Pétrole*, 1947, **2**, 131–140, 195–200.—Two aspects of the kinetics of contact catalysis are examined, adsorption and reactions in the adsorbed phase. By interrupting a normal catalytic reaction, cooling the catalyst zone in the presence of the reactants and transferring the cold catalyst, with exclusion of air, to a special apparatus (not described) it is possible to study the gases given off on desorption as the temperature rises, the most loosely adsorbed products being evolved first. A study of the catalyst in the course of catalytic cracking with hydrogenation showed a high concentration of methane to be present, although none of this material was present in the feed and only a small amount in the product. It is therefore concluded that the adsorbed phase has a high concentration of CH_3, CH_2, and CH radicals; the isomerization process can thus be considered as being one of methylation. In seeking to find a reaction in which the rôle of methane could be experimentally demonstrated, thermodynamic considerations pointed to the Fischer–Tropsch synthesis as being one in which this effect ought to be evident at atmospheric pressure. Experimental addition of methane to synthesis gas shows it to participate in the reaction. The use of methane decreases the induction period of the Fischer–Tropsch catalyst (during which large quantities of methane are normally produced); a similar effect is obtained by the dilution of the synthesis gas with an inert material such as nitrogen. It is considered that the large initial formation of methane normally observed is due to the heating up of fresh catalyst; if the temperature is kept low then condensable aliphatic hydrocarbons can be obtained almost immediately. V. B.

Metering and Control.

1196. Reciprocating—Pump Calculations—Part I. Refiners' Notebook, No. 144. W. L. Nelson. *Oil Gas J.*, 17.5.47, **46** (2), 113.—A very brief account is given of the method of operation of steam-driven reciprocating pumps, together with an explanation of the following terms: double-acting, simplex; duplex; outside end-packed plunger; head volumetric efficiency; hydraulic efficiency; mechanical efficiency;

piston speed; discharge pressure. A table of piston speeds and mechanical efficiencies is included for strokes of 3–36 in. W. M. H.

1197. A General Pressure–Volume–Temperature Correlation—for Mixtures of California Oils and Greases. M. B. Standing. *Oil Gas J.*, 17.5.47, **46** (2), 95.—The paper presents correlations between physical properties measured in the field and those necessary for solution of reservoir performance problems. The gas–oil ratios, gas gravities, oil gravities, and formation volumes given here are laboratory values, and are obtained from a two-stage flash separation at 100° F. The first stage is in the pressure range 250–450 p.s.i., the second stage at atmospheric pressure; the procedure approximates the average California field practice. Graphs are presented for prediction of bubble-point pressures, formation volume of bubble-point liquid, and formation volume of gas plus liquid phases; equations show the effect of the several variables on bubble-point pressure. Four references are given. W. M. H.

Safety Precautions.

1198. Benzene Solvents and Industrial Hygiene. A. Vallaud. *Chim. et Ind.*, 1947, **57**, 391–394.—A brief review of the dangers of benzol poisoning in the industries connected with rubber solutions, rubber manufacture, dry cleaning, printing, and paint manufacture. The intoxication threshold for benzene vapours is considered to be 0·1 g/m³. Risks of benzol poisoning increased in France during the war due to shortage of low aromatic content petroleum solvents and the re-introduction of these latter is recommended. V. B.

1199. Fires and Explosions at Oil Installations. E. P. Lancashire. *J. Inst. Petrol.*, 1947, **33**, 131.—Detailed accounts of twelve major oil fires during the years 1940 to 1945 are given, and items such as protection measures, application of foam, and salvaging are discussed. J. T.

1200. Fires in Open Tanks of Petroleum Products: Some Fundamental Aspects. J. H. Burgoyne and L. L. Katan. *J. Inst. Petrol.*, 1947, **33**, 158.—Observations have been made upon the behaviour of a representative selection of petroleum products when burnt in open-topped cylindrical vessels. It has been shown that many refined oils burn in such a way that virtually all the fractions are removed layer by layer leaving little or no residue of any kind, and the bulk of the oil, apart from a comparatively shallow layer near the surface, is not at all affected by the fire. Crude and residual oils, and motor spirits have, however, been found to burn in such a way that only the lighter fractions are removed layer by layer and a hot residue steadily accumulates, floating on the unaffected oil.

The hot residue, especially if its temperature exceeds 100° C (as it does with crudes and fuel oils), constitutes a hazard particularly when extinction of the fire by the use of water in some form is attempted. It is suggested that in these circumstances the body of the cold oil below may be used to cool the hot residue and thus remove the hazard. Some ways of doing this are examined and it is shown that the method not only removes much of the danger but may be extended, within limitations that are defined, to the complete extinction of the fire without the use of auxiliary measures, both in oils that do and do not form the hot residue during the burning. J. T.

1201. Experiments on the Rate of Foam Application on Petrol Fires. N. O. Clark, E. Thornton, and J. A. Lewis. *J. Inst. Petrol.*, 1947, **33**, 192.—The nature of the relationship between application rate of foam and control of the fire and the effect of expansion factor on this relationship are investigated. Each foam on a given fire exhibits a critical rate of delivery below which no progress towards extinction is made. The most desirable expansion factor for the *foam compound solution used* appears to lie in the region of ten. The consumption of extinguishing materials is independent of the expansion factor up to the point of control being obtained over the fire. It may probably be wiser to specify application rate in terms of water delivery, than to follow the existing practice of foam rate specification, as this would be made less dependent on the efficiency of the apparatus. Experiments indicate very little dependence on

the linear velocity of application, and an increase in the critical rate arising from lengthier initial burning.

All bottom injection experiments failed to control the fire, not because the foam was destroyed, but presumably because it lifted the petrol. J. T.

Refining Patents.

1202. Patents on Refining Processes and Products. American Cyanamid Co. B.P. 588,090, 29.5.47. Production of lub. oil compositions and of additives.

B. L. P. Anthony. B.P. 588,283, 29.5.47. Sulphur containing lubricants.

Carbide and Carbon Chemical Corpn. B.P. 588,143, 29.5.47. Polymerization of ethylene.

L. C. Moore & Co. Inc. B.P. 588,105, 29.5.47. Oil-well masts.

Shell Development Co. B.P. 588,099, 29.5.47. Catalytic production of phenolic compounds.

Standard Oil Development Co. and J. C. Arnold. B.P. 588,037, 29.5.47. Process for the separation of C_5 diolefins from hydrocarbon mixtures.

Anglo-Iranian Oil Co. Ltd., W. A. Partridge, and H. J. Alty. B.P. 588,455, 4.6.47. Motor fuels.

E. P. Newton (S.O.C. California). B.P. 588,461, 4.6.47. Multicylinder engine detonation measurement.

J. C. Arnold (S.O. Dev. Co.). B.P. 588,466, 4.6.47. Manufacture of solidified mineral oils.

C. Arnold (S.O. Dev. Co.). B.P. 587,790, 21.5.47. Catalytic conversion of hydrocarbons.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,813, 21.5.47. Production of aviation gasoline.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,955, 21.5.47. Lubricating grease compositions.

J. C. Arnold (S.O. Dev. Co.). B.P. 587,977, 21.5.47. Production of polymers.

H. G. C. Fairweather (Cities Service Oil Co.). B.P. 587,934, 21.5.47. Gas analysers.

Manchester Oil Refinery Ltd. and F. C. Hill. B.P. 587,787, 21.5.47. Homogenizing apparatus.

Shell Development Co. B.P. 587,914, 21.5.47. Production of phenolic resins.

Socony-Vacuum Oil Co. Inc. B.P. 587,969, 21.5.47. Manufacture of halogenated hydrocarbons.

J. C. Arnold (S.O. Dev. Co.). B.P. 588,565, 11.6.47. Anti-corrosion mineral oil compositions.

R. Gallia. B.P. 588,571, 11.6.47. Burners for liquid fuels.

J. C. Arnold (S.O. Dev. Co.). B.P. 588,684, 11.6.47. Solidified or gelled mineral oils.

Standard Oil Development Co. B.P. 588,760, 18.6.47. Apparatus for catalytic chemical reactions.

C. Arnold (S.O. Dev. Co.). B.P. 588,823, 18.6.47. Production of artificial fogs.

J. C. Arnold (S.O. Dev. Co.). B.P. 588,824, 18.6.47. Production of co-polymers.

C. C. Wakefield & Co., Ltd., E. A. Evans, and J. S. Elliott. B.P. 588,864, 18.6.47. Lub. oils having anti-corrosive properties.

Anglo-Iranian Oil Co., Ltd., L. C. Strang, and J. Owen. B.P. 588,976, 18.6.47. Refining of hydrocarbons.

J. C. Arnold (S.O. Dev. Co.). B.P. 588,835, 18.6.47. Combined alkylation and polymerization processes.

Standard Oil Development Co. B.P. 589,072, 25.6.47. Production of ethylbenzene.

Standard Oil Development Co. B.P. 589,073, 25.6.47. Vulcanized compositions.

Standard Oil Development Co. B.P. 589,130, 25.6.47. Catalytic conversion of hydrocarbons.

J. C. Arnold (S.O. Dev. Co.). B.P. 589,233, 25.6.47. Lub. oil compositions.

J. C. Arnold (S.O. Dev. Co.). B.P. 589,045, 25.6.47. Low temperature polymerization of olefines.

J. C. Arnold (S.O. Dev. Co.). B.P. 589,054, 25.6.47. Contacting divided solids and gaseous fluids.

C. Arnold (S.O. Dev. Co.). B.P. 589,058, 25.6.47. Catalytic isomerization of paraffin hydrocarbons.

J. C. Arnold (S.O. Dev. Co.). B.P. 589,248, 25.6.47. Preparation of synthetic rubber-like materials.

Lobitos Oilfields Ltd., and J. C. Wood-Mallock. B.P. 589,149–50, 25.6.47. Manufacture of electrical insulating oils.

Gulf Research and Development Co. B.P. 589,070, 25.6.47. Alkylation of phenols.

C. L. Thomas and V. Haensel, assrs to U.O.P. Co. U.S.P. 2,410,111, 29.10.46. An alkylated aromatic is obtained by reacting an olefine and an aromatic in the presence of a silica–zirconia catalyst.

J. D. Danforth, assr to U.O.P. Co. U.S.P. 2,410,151, 29.10.46. An aromatic is alkylated with an olefine in the presence of $AlCl_3$ catalyst.

T. B. Kimball, assr to Sinclair Refining Co. U.S.P. 2,410,166, 29.10.46. The toluene cut of a gasoline is extracted with liquid SO_2 and the extract + liquid SO_2 is washed with a paraffin fraction to concentrate the toluene in the extract.

H. R. Legateki, assr to Phillips Petroleum Co. U.S.P. 2,410,223, 29.10.46. Removal of moisture and hydrogen sulphide from low-boiling hydrocarbons by a combination of fractionation and caustic soda treatment.

T. P. Simpson, J. W. Payne, and J. A. Crowley, Jr., assrs to Socony Vacuum Oil Co., Inc. U.S.P. 2,410,309, 29.10.46. A catalytic cracking process on the Thermofor principle.

E. O. Sowerwine, Jr., assr to Socony Vacuum Oil Co., Inc. U.S.P. 2,410,314–5, 29.10.46. An apparatus for preparing formed gels.

C. L. Thomas, assr to U.O.P. Co. U.S.P. 2,410,316, 29.10.46. High octane motor fuel is obtained by catalytic reforming of the cracked gasoline from a thermal cracking operation.

J. F. Hyde, assr to Corning Glass Works. U.S.P. 2,410,346, 29.10.46. A liquid polymeric organo-siloxane is used as a lubricant.

V. N. Jenkins, assr to Union Oil Co. U.S.P. 2,410,381, 29.10.46. Manufacture of a syntholub. from paraffin wax by processes involving chlorination, dichlorination, catalytic polymerization, and propane extraction.

S. A. Lonkomsky and C. R. Stock, assrs to American Cyanamid Co. U.S.P. 2,410,385, 29.10.46. A spinning cup viscometer.

F. J. Ewing, assr to Filtrol Corpn. U.S.P. 2,410,436, 5.11.46. Manufacture of an aluminated acid leached montmorillonite clay for use as a cracking catalyst.

V. N. Ipatieff and H. Pines, assrs to U.O.P. Co. U.S.P. 2,410,445, 5.11.46. A diolefine is obtained by reacting an alcohol and an acetylene in the presence of an oxide catalyst.

E. M. Dons and O. G. Mauso, assrs to Mid-Continent Petroleum Corpn. U.S.P. 2,410,483, 5.11.46. Apparatus for preparing uniform wax crystals in a solvent dewaxing process.

H. J. Hepp, assr to Phillips Petroleum Co. U.S.P. 2,410,498, 5.11.46. Production of di*iso*propyl by the reaction between *iso*butane and ethylene in the presence of an $AlCl_3$ catalyst.

L. Schmerling and V. N. Ipatieff, assrs to U.O.P. Co. U.S.P. 2,410,553, 5.11.46. A zinc chloride catalyst is used in the reaction between a ketone and an aromatic to produce an alkyl aromatic.

H. Pines and V. N. Ipatieff, assrs to U.O.P. Co. U.S.P. 2,410,554, 5.11.46. An alkylaromatic is obtained by the reaction between an aromatic and an aliphatic unsaturated ketone in the presence of hydrofluoric acid.

G. M. Webb and M. A. Smith, assrs to U.O.P. Co. U.S.P. 2,410,558, 5.11.46. A method of preparing an alumina–metal oxide catalyst.

J. J. Giammaria, assr to Socony Vacuum Oil Co., Inc. U.S.P. 2,410,578, 5.11.46. A lignin ester of an aliphatic acid is used as a lub. oil additive.

A. J. L. Hutchinson, assr to The Fluor Corpn. U.S.P. 2,410,583, 5.11.46. A method of separating hydrate forming components of gaseous mixtures using water and CCl_4.

J. D. Morgan, assr to Cities Service Oil Co. U.S.P. 2,410,608, 5.11.46. Trialkyl phosphate containing a corrosion-resisting agent and a pour-point depressant is used as a hydraulic liquid which is characterized by a small change of viscosity with temperature.

A. D. Pickett, assr to Phillips Petroleum Co. U.S.P. 2,410,610, 5.11.46. A grease gun lubricant is made from a 3 to 1 mixture of aluminium and lead soaps dissolved in sufficient solvent.

R. F. Ruthruff. U.S.P. 2,410,613, 5.11.46. A mixture of lub. oil and a suitable fraction of a catalytically reformed heavy naphtha is used as a flushing oil.

A. Farkas and A. F. Stribley, Jr., assrs to Union Oil Co. U.S.P. 2,410,642, 5.11.46. A process for the oxidation of naphthene hydrocarbons.

J. J. Giammaria, assr to Socony-Vavuum Oil Co., Inc. U.S.P. 2,410,650, 5.11.46. A detergent and anti-corrosive lub. oil additive consisting of an oil miscible metal salt of a wax-phenyl substituted thio acid of phosphorus.

J. R. Griffin, Jr., and P. R. Van Ess, assrs to Shell Dev. Co. U.S.P. 2,410,652, 5.11.46. An oil miscible metal salt of the condensation product of an aldehyde and an aromatic hydroxy compound is added to a lub. oil to give high temperature detergent properties.

D. B. Luten, Jr., assr to Shell Dev. Co. U.S.P. 2,410,829, 12.11.46. A mononuclear aromatic amine is added to a gasoline to reduce knock. The gasoline is stabilized by the addition of a 2 : 4-dialkyl phenol.

F. S. Rostler, V. M. Wilson, and H. I. du Pont, assrs to Wilmington Chemical Corpn. U.S.P. 2,410,839, 12.11.46. Unsaturated hydrocarbons are separated from paraffins by double solvent extraction with heptane-furfural.

E. L. Walters, assr to Shell Dev. Co. U.S.P. 2,410,846–7, 12.11.46. Phenol derivatives and alkyl aromatic amines are used as stabilizers and anti-knock agents respectively for gasoline.

E. Lieber, assr to S.O. Dev. Co. U.S.P. 2,410,885, 12.11.46. A Friedal–Crafts recondensation product is used as a pour-point depressant.

R. B. Mason, assr to S.O. Dev. Co. U.S.P. 2,410,890, 12.11.46. Manufacture of a sulphide catalyst for use in the reduction of nitroaromatic compounds.

R. N. Meinert and P. H. Holt, assrs to S.O. Dev. Co. U.S.P. 2,410,891, 12.11.46. Catalytic reforming of naphtha employing fluid catalyst.

C. W. Montgomery, assr to Gulf Research and Dev. Co. U.S.P. 2,410,894, 12.11.46. Isomerization of *n*-butane using a dissolved aluminium halide catalyst.

E. W. Thiele, G. E. Schmitkins, and C. M. Hull, assrs to S.O.C. Indiana. U.S.P. 2,410,908, 12.11.46. A naphtha from thermal cracking is subjected to *iso*-forming to raise its O.N.

J. I. Wasson and W. M. Smith, assrs to S.O. Dev. Co. U.S.P. 2,410,911, 12.11.46. A method of making a solution of a condensed organic amino compound in lub. oil.

C. A. Coghlan, assr to The Texas Co. U.S.P. 2,411,025, 12.11.46. Polyethylene glycol is used to extract butadiene from hydrocarbon mixtures.

E. F. Engelke and W. W. Odell, assrs to Lion Oil Co. U.S.P. 2,411,032, 12.11.46. A phosphorized mixture of a soap and a higher molecular monohydric alcohol is used as an anti-oxidant in lub. oil.

C. B. Linn and V. N. Ipatieff, assrs to U.O.P. Co. U.S.P. 2,411,047, 12.11.46. Boron trifluoride and an acid fluoride are used in the catalytic alkylation of aromatics.

O. L. Davis and A. C. Nixon, assrs to Shell Dev. Co. U.S.P. 2,411,083, 12.11.46. The addition of an alkyl amine to caustic soda reduces its tendency to form emulsions in the treatment of hydrocarbons.

A. C. Nixon and D. L. Yabroff, assrs to Shell Dev. Co. U.S.P. 2,411,105, 12.11.46. A salt of a naphthenic acid is used to break emulsions obtained in the caustic soda treatment of hydrocarbons.

T. A. Petry and G. L. Payne, assrs to Socony-Vacuum Oil Co. U.S.P. 2,411,106, 12.11.46. Styrene is separated from ethylbenzene by azeotropic distillation with ethylene glycol mono-ethyl ether.

C. E. Adams, assr to S.O.C. Indiana. U.S.P. 2,411,141 and with C. D. Kelso, U.S.P. 2,411,142, 19.11.46. Preparation of amine resins.

H. C. Evans and D. W. Young, assrs to S.O. Dev. Co. U.S.P. 2,411,150, 19.11.46. A non-volatile oxy-ester is added to a thickened lub. oil to reduce the viscosity at 100° F.

E. W. Fuller, H. G. Berger, and R. H. Williams, assrs to Socony-Vacuum Oil Co., Inc. U.S.P. 2,411,153, 19.11.46. The reaction product of phosphorus pentasulphide and oleyl alcohol is used as a lub. oil additive. G. R. N.

PRODUCTS.

Chemistry and Physics.

1203. Explosive Decomposition of Ethene. H. I. Waterman, W. J. Hessels, and J. Van Steenis. *J. Inst. Petrol.*, 1947, **33**, 254.—An explosion may occur when ethene is being polymerized with aluminium chloride as a catalyst in the presence of finely divided nickel as promoting agent at room temperature and about 60 atm pressure. Some solvents for the aluminium chloride also promote the polymerization of olefins in which case also an explosion may occur with a starting pressure of 40 atm at temperatures as low as 0° C. A lower starting pressure of ethene (20 atm) also gives rise to a vigorous reaction. Four examples describing the reactions are given. J. T.

1204. Separation of a Two-Component Mixture by Distillation in the Presence of a Carrier. J. P. Zwilling. *Chim. et Ind.*, 1947, **57**, 336–340.—The vaporization of a two-component non-azeotropic mixture in the presence of a third, immiscible, component is examined by the aid of triangular diagrams; the representation can be simplified to a rectangular diagram on which are plotted merely the relative concentrations of the miscible products. A typical calculation of column dimensions for continuous distillation in such circumstances is given, together with a simplified flow diagram. The use of graphic rather than tedious arithmetical solutions is to be preferred. The vapour composition is expressed in terms of fictitious percentage units, which are equivalent as regards their heats of vaporization. V. B.

1205. On Turbulent Flow in Rough Tubes. V. G. Nevzgljadov. *Compt. Rend. (Doklady) Acad. Sci. URSS*, 1947, **55**, 103 (in English).—The author's phenomenological theory of turbulence is applied to an earlier treatment of flow in smooth-walled circular tubes to provide a solution of the problem of flow in tubes with rough walls. The equations obtained, one of which contains a universal function of viscosity previously considered by Stanton and Karman, are compared with experimental data obtained by Nikuradse. The curves calculated from the author's equations are in excellent agreement with the experimental points. G. H. B.

1206. Power Laws of Latent Heat, Orthobaric Density, Surface Tension, and Viscosity of Liquids. W. J. Jones and S. T. Bowden. *Phil. Mag.*, 1946, **37**, 480.—The results

are given of a survey of the region extending about 200° downwards from the critical temperature for all the liquids for which data are available. Good agreement with experimental values has been obtained by equations of the following types :—

$$\lambda = \lambda_0(1 - T/T_C)^{m_0},$$
$$l = l_0(1 - T/T_C)^{m_0},$$
$$\lambda = \lambda_1(D - d)^{m_1},$$
$$l = l_1(D - d)^{m_1},$$
$$\lambda = \lambda^1\sigma^{m^1},$$
$$l = l^1\sigma^{m^1},$$
$$\lambda = \lambda^{11}(\eta - \eta_c)^{m^{11}},$$
$$l = l^{11}(\eta - \eta_c)^{m^{11}},$$
$$\sigma = \sigma^1(\eta - \eta_c)^{n^1},$$

where λ and l represent the internal and total latent heat, and D and d are the liquid and vapour orthobaric density respectively. The absolute temperature is represented by T, viscosity by η, absolute critical temperature by T_C, and empirical constants for each substance and relation by the remaining symbols. J. T.

1207. Infra-Red and Raman Spectrum of *cyclo*-Octatetraene. M. St. C. Flett, W. T. Cave, E. E. Vago, and H. W. Thompson. *Nature*, 1947, **159**, 739.—The Raman spectrum of liquid *cyclo*-octatetraene, and the infra-red spectrum between 2 and 20 μ of the liquid and vapour have been measured. A list of Raman displacements and infra-red bands is given. Results agree in general with previous measurements, but some discrepancies were noted.

The infra-red spectrum of the solid polymer formed from *cyclo*-octatetraene on standing suggests that hydroxyl groups are present in this compound. H. C. E.

1208. Infra-Red Spectrum of C_nD_{2n+2} and the "Long Chain Frequency" in Paraffins. N. Sheppard and G. B. B. M. Sutherland. *Nature*, 1947, **159**, 739.—The most characteristic feature of the infra-red spectrum of a long-chain paraffin is a strong band near the wave-length 14 μ, which has been shown to be associated with the group $-(CH_2)_nCH_3$ ($n \geqslant 3$), but for which no satisfactory explanation has been given. It is found that this band is shifted to longer wave-lengths by approximately $\sqrt{2}$ in the spectrum of C_nD_{2n+2}, indicating that it is caused by a vibration associated with the hydrogen atoms. H. C. E.

1209. Study of Some Organographitic Substances by X-Ray Diffraction. H. A. Sack and J. J. Trillat. *Compt. Rend.*, 1947, **224**, 1502.—Thermal decomposition of an organic compound results in the formation of substances with some of the properties of graphite, but still related to specific organic compounds by elementary composition and chemical reactivity. These substances are designated organographites, and possess the characteristic lack of solubility and extremely low vapour pressure of graphite itself, and also show the X-ray diffraction features of graphite typical of the "turbostratic" state defined by Biscoe and Warren. Each of the lamella which constitute the individual crystalline units form a macromolecule almost entirely composed of hexagonal rings of carbon atoms to which the atoms of other elements present are attached at the periphery. The characteristic X-ray feature of the organographites is a large diffuse central plateau of constant intensity.

The X-ray diffraction patterns, obtained with copper Kα radiation and a sodium chloride monochromator, of Micronex carbon-black, the discontinuous (pitch) phase of coal-tar, and a bitumen separated from Mexican petroleum by electrophoresis in nitrobenzene solution have been obtained. The results reveal a similarity in structure for the carbon-black and the coal-tar pitch. The petroleum bitumen gives the characteristic organographitic plateau and 3·35 Å graphite spacing found in the other two specimens, but also a diffuse ring at 4·35 Å resembling a liquid diffraction pattern and two spacings at 2·88 and 2·37 Å which do not belong to the organographitic system. It is concluded, in opposition to Nellensteyn, that petroleum bitumen cannot be identified on the basis of X-ray diffraction evidence as a graphite or organographite.

G. H. B.

1210. Viscosity as a Function of Temperature. A. H. Stuart. *Petroleum*, April 1947, **10**, 74.—Various formulæ have been suggested for expressing the relationship between viscosity and temperature, but these have been entirely arbitrary. As an example, mention may be made of the well-known A.S.T.M. Viscosity Formula :

$$\log.\log.(v + 0{\cdot}8) = A \log. T + B$$

where v is the viscosity and T the absolute temperature, A and B are constants for any one oil. This formula has proved of great use for Viscosity Index determinations, but it is quite an arbitrary relationship and has no mathematical or physical basis.

With a view to establishing a more fundamental relationship the writer examined a number of viscosity–temperature curves relating to lubricants and other oils. In no case could an equation be found to fit the curve.

Attention was therefore turned to viscosity measurements of pure chemical compounds commencing with water. The viscosity–temperature curve for water suggests an equation of the type $y = ax^{1/t}$, and viscosity, v, would be expected to be expressed in terms of temperature, t, by $v = ax^{-1/t}$ yet no such equation was found to fit the curve. Success was achieved by the use of an equation of the type $t = ax^{-1/v}$, which more conveniently arranged would be $v = A - B \log. t$, where A and B are constants.

The relationship between viscosity and temperature for water may then be expressed by $v = 2{\cdot}34 - 1{\cdot}04 \log. t$, where v = viscosity in centipoises, t = temperature in ° C, and the logarithms are to the base 10. Close agreement was obtained between observed values and those obtained from the graph of the equation given. While the Centigrade scale of temperature has a direct reference to the physical properties of water it is completely arbitrary when applied to anything else. In the case of ethyl alcohol, therefore, a simple mathematical relationship between viscosity and this arbitrary scale of temperature would hardly be expected. A scale of temperature was therefore sought which would bear the same relationship to alcohol as the Centigrade scale to water. This is done by taking the zero of the scale at the melting point of alcohol, viz. — 117·3° C, the Centigrade degrees being taken as the graduation. Using this scale of temperature a similar equation to that obtained for water is derived, thus $v = 4{\cdot}2 - 1{\cdot}16 \log. t$.

Similarly, equations of the same type for Lead, Mercury, Hexane, Heptane, Octane, Ethyl Ether, and Aniline are derived of the type $v = A - B \log. t$.

An equation for Benzene could be derived if — 15° C were taken as the solidification point (and hence the temperature scale zero), but not if the usual melting point (5·48° C) is taken.

Acetone, which has a melting point of — 95° C, follows an equation of $v = 2{\cdot}51 - 1{\cdot}07 \log. t$ over a temperature range of — 13° C to 20° C; from 30° C to 40° C, however, the results fall out of line. Acetone does not behave normally at temperatures approaching its boiling point (56·5° C). Sulphur also presents a notable example of anomalous viscosity.

In all cases quoted, agreement between observed values for viscosity and those indicated by the equations is as close as one normally obtains with experimental values, and there can be little doubt that a mathematical relationship exists.

Since lubricating oils have no fixed melting points attempts to establish this relationship have failed.

Before it is possible to extend this type of mathematical analysis to lubricating oils it will be necessary to have more precise knowledge of their chemical constituents.

F. W. H. M.

Analysis and Testing.

1211. Infra-Red Absorption Analysis of Gases and Vapours (2). 2. General Features of Limited Radiation Analysers. R. Quarendon. *Petroleum*, April 1947, **10**, 78.—In this second article some general features of design of limited radiation analysers are considered. They consist of five chief parts, usually in the following order :—

(1) The source of radiation and focusing device.
(2) Absorption cell containing the gas.
(3) The arrangement for dispersing the radiant beam and selecting the appropriate wave-length for measurement, known as the monochromator.

(4) The detector which receives the residual radiant energy after absorption, and transforms it into a form suitable for measurement.

(5) The measuring apparatus for indicating or recording the output of the detector with or without the help of some form of amplifier.

These are described in detail. Alternative types of the various apparatus used in analyser construction are described and their characteristics discussed.

It is in the development of sensitive and stable receivers for detecting the energy of the dispersed beam, and of the rugged and robust apparatus for measuring it that the most spectacular advances have been made in recent years. Nowadays, very sensitive and stable systems incorporating either a vacuum thermocouple or a bolometer are available. Modern vacuum thermocouples can generate 100 microvolts for 1° C rise in temperature and have a uniform response over the wave-length range 0·3 to 35 microns. The Schwarz thermopile, which consists of these thermocouples, has a sensitivity of 60 microvolts per microwatt of energy, and is designed to permit of easy fitting to the analyser. The power in the dispersed beam available under average conditions of analysis is only about one-tenth of a microwatt, or only a small fraction of this under unfavourable conditions.

To achieve the desired accuracy of analysis under average conditions a change in thermocouple output of 0·05 microvolt must be detectable and possibly one-hundredth of this amount under unfavourable conditions. With the most sensitive thermopile these figures can perhaps be multiplied by 5.

Various methods of amplification can be employed to obtain this sensitivity of measurement, for instance, the energy detector may be connected to a primary galvanometer whose deflection may be amplified by a photo-electric amplifier and measured on a second galvanometer. Thermocouple-amplifier systems have been designed to detect variations as small as 0·0005 microvolt.

Little published information is available regarding bolometer systems, but they are concerned with similar small amounts of energy.

The precise means adopted depends largely on the nature of the analysis and the amount of energy available for measurement. Arrangements employed by various users and manufacturers are described and their relative merits discussed.

F. W. H. M.

1212. Ballistic Viscosimetry. F. Charron. *Compt. Rend.*, 1947, **224**, 1472.—A theoretical treatment is developed for the following system. A capillary tube is attached to a cylinder closed by a sliding piston, the whole being filled with a viscous liquid. A ballistic pendulum is used to apply a shock load to the piston, the kinetic energy of the pendulum being defined by its dimensions and initial angular displacement. The development of the shock load can be regulated with respect to time by, *e.g.*, inserting a device with variable frictional characteristics between the piston and pendulum. An equation is derived for the viscosity of the liquid in the cylinder under these conditions which does not require the experimental measurement of short time intervals or rapidly changing velocities but only the final displacement of the piston. It is thus possible to study the increase in viscosity of the liquid under high pressures of very short duration. The technique is being applied to the behaviour of lubricant films under conditions of shock loading. G. H. B.

Crude Oils.

1213. Crude Oil of England. J. S. Parker. *J. Inst. Petrol.*, 1947, **33**, 230.—The article takes up the history of indigenous crude oil from the field rail sidings of a previous article (Southwell, C. A. P., *J. Inst. Petrol.*, 1945, **31**, 27) and covers its progress through to the finished products.

The period covered is 1942 to 1945 when the main requirements, for war purposes, were lubricating oils and waxes. The stress of the article is thus on the refining of indigenous crude oil for these products.

The quality of the crude oil from the main producing fields for lubricating oil manufacture is first covered. This shows that the crude oils are all of the same general waxy type. Within this general type there are two distinct groups :—

(1) Paraffin base with low sulphur and asphaltene content and containing lubricating oils of high viscosity index.

(2) Intermediate base with high sulphur and asphaltene content and containing lubricating oils of medium viscosity index.

Group (1) comprised the major production during the years covered.

Reference is made to similar crudes produced in France and Germany.

The initial laboratory research work on indigenous crude oil, as guidance for the later practical scale operations, is given in detail. This is followed by complete detail of all the practical scale operations involved, together with the qualities of the resultant products. General information is given on the total tonnage of the products manufactured and their destination. J. T.

Engine Fuels.

1214. Turbine Fuels and Oils. C. G. Williams. *Flight*, 26.6.47, **51**, 600.—At present combustion is largely influenced by mechanical and aerodynamic factors. However, many factors are known which influence the choice of fuel. Regarding the addition of lubricating oil to inhibit water, it is confidently expected that neither kerosine nor gasoline will require added lubricant. Ice clogging can be delayed by the use of a filter or eliminated by 10% of an alcohol anti-freeze agent. As to availabilities, the author suggests the use of a distillate fuel of low viscosity and high volatility offering advantages in atomization, cold starting, blow-out, and carbon deposition. This could be made available in large quantities. I. G. B.

Gas Oil and Fuel Oil.

1215. Jet-Heat Furnace. C. MacCracken. *Fuel Oil and Oil Heat*, Feb. 1947, **5** (10), 66.—A new type of domestic heating furnace has recently been developed in America, utilizing the principles of jet propulsion.

The motor-driven blower fan distributes both combustion air and circulating air, the latter passing over a heat-exchange system. Air for combustion, considerably in excess of that needed, passes to a small combustion chamber which is fitted with an automatic type spark plug for initial ignition. An electronic "eye" control is used to automatically stop the fuel oil flow if the flame accidentally goes out or the mixture is not ignited on starting. The fuel used is catalytically cracked fuel-oil, which is filtered before reaching the pump. Exhaust gases are cooled by passing through the heat exchanger (in which layers of circulating air and combustion gases alternate), and are expelled through an exhaust tube.

A humidifier controls the humidity of the heated circulating air, which then passes into ducts for room heating. Before reaching the room, the temperature and the speed of the heating air can be reduced by introducing external air into the system.

These furnaces are made in two capacities, one utilizing a ½ h.-p. motor, and having a fuel consumption of ½-gal/hr with an output of 65,000 B.Th.U.'s/hr. The other type has double this output. C. D. B.

Lubricants.

1216. Steam Turbine Lubrication Problems and Their Solutions. 3(4) Turbine Oil Demulsibility and its Practical Significance. A. Wolf. *Petroleum*, April 1947, **10**, 76.—The characteristics of turbine oils are discussed with special reference to demulsibility and oxidation stability.

Prior to the publication in 1933 of the first B.S.S. turbine oil specification, no general standards were laid down for the oxidation stability of turbine oils. The average consumer was therefore under the impression that demulsibility was the most important property of a turbine oil provided it satisfied viscosity requirements.

The introduction of solvent-refining and the development of modern turbines have shown this impression to be fallacious, since serious troubles can now arise by neglecting the oxidation stability factor. That is, while demulsibility is still important, it must be accompanied by resistance to oxidation under service conditions.

Before the introduction of solvent refined oils, Penna turbine oils were the best because of their greater inherent oxidation resistance than any other (non-solvent refined) lub. oil. They could be refined to a high demulsibility, which property ran roughly parallel with chemical stability under oxidation inducing conditions.

The requirements of modern turbines and the development of solvent-refined oils have made it desirable to use, in some cases, anti-foaming and corrosion-inhibiting additives. These substances, however, may adversely affect the demulsibility of the original oil. This leads to the question as to whether the very low steam emulsion test numbers (S.E. numbers) demanded for high-class new turbine oils are really necessary. The conclusion is reached that they are not.

Demulsibility is enormously influenced by traces of emulsifiers entering the oil; it is therefore not surprising that the S.E. number of a turbine oil usually increases greatly after only a few hours in a normally clean lubrication system. The practical advantage of insisting on a very low initial S.E. number is therefore questionable. The demulsibility after periods of use in the lubrication system should be obtained and compared with that of the original oil.

Penna oils have often been known to acquire very high S.E. numbers without any sign of lubrication troubles attributable to lack of demulsibility.

Solvent-refined, oxidation-inhibited turbine oils usually show a minimum increase in S.E. number with use.

Considerations of maximum permissible S.E. numbers is discussed from a practical point of view.

Theoretically, an S.E. number of 360 to 480 should suffice for large modern turbines. It is found in practice that the S.E. number of solvent-refined turbine oils rarely exceeds 300 to 400, even after several months' use.

Whereas the old-type Penna oils, after severe oxidation, showed poor demulsibility, with solvent-refined oils the reverse is often the case, in fact the S.E. number may actually fall as oxidation progresses. In this latter case, a low demulsibility alone should not be taken as the criterion of the condition of the oil, but it should be coupled with low acidity to be assumed in good condition.

Oils refined by acid and soda treatment commonly show poor demulsibility, the worst being heavily acid and soda treated naphthenic or asphalt-base type. These possess high specific gravities—0·930 to 0·940 at 60° F—whereas solvent refined oils seldom exceed 0·910.

Detergent additives in H.D. oils, used to lubricate high-performance diesel generators, are bad emulsifiers. Increasing use in modern turbo-driven ships of these generators leads to the risk of contamination of the turbine oil by the H.D. oil thus impairing its demulsibility characteristics. Painting of the interiors of turbine oil reservoirs has often been followed by serious troubles. F. W. H. M.

Bitumen, Asphalt, and Tar.

1217. Specifications for Bitumens for Use in Road Work. R. Ariano. *Ricerca sci e ricostruz.*, 1947, **17** (2–3), 165–180.—A review is given of the specifications, including tests, proposed by the "Commission for Study of Road Problems" of the Italian National Research Council in 1943. D. H. McL.

Special Hydrocarbon Products.

1218. Petroleum Products in Agriculture: The Rôle of Petroleum in Plant Protection. L. W. Leyland Cole. *J. Inst. Petrol.*, 1947, **33**, 203.—The immense loss of food crops, due to weed competition and to the activity of insects and fungi in the field and in the warehouse, is being reduced by the development of new and more effective methods of plant protection.

Petroleum oil has been used for a long time in the form of oil–water emulsions for application to deciduous and to citrus fruit, and in recent years chemicals derived from petroleum have found many applications in agricultural pest control. The base oils of horticultural sprays have certain accepted characteristics, but more work by the biochemist and plant physiologist is required before the perfect spray oil can be evolved. In practice, dilute oil emulsions of various types are sprayed on the tree both in winter and in summer, care being taken to combine maximum insecticidal effect with minimum phytotoxicity. Oil is an excellent insecticide in itself, but it is also an important carrier for other insecticides and for fungicides. Certain petroleum fractions possess weed-killing properties and are useful both as selective and non-selective herbicides.

Important chemicals derived from petroleum and used in pest control are ester salts, methallyl chloride, and a mixture of dichloropropene and dichloropropane (D-D), the latter being a very successful soil fumigant. J. T.

Engines and Automotive Equipment.

1219. Fedden Power Units. Anon. *Flight*, 26.6.47, **51**, 600a.—Orders for two engines, the flat-six and the Cotswold airscrew turbine, have been cancelled, but details of the designs are made known. The gas turbine consists of an 11-stage axial compressor (5·75 : 1), seven combustion chambers of divergent shape (fuel injected upstream—loss factor 4%) and a 2-stage turbine. The reduction gear ratio is 14·785 : 1.

The 5·3 litre flat-six was designed to be completely submerged in a wing. Detonation free running has been obtained at an 8 : 1 C.R. on 90-octane fuel. I. G. B.

1220. Application to Engines of Temperature Measurement by Resistance Thermometers. R. Vichnievsky, R. Guyot, G. Monnot, and M. du Parquet. *Rev. Inst. Franç. Pétrole*, 1947, **2**, 67–80, 155–158, 201–211.—Temperatures within the cylinder of an I.C. engine can be measured by means of a special plug carrying a spiral of 0·01–0·04 mm dia tungsten wire and forming one arm of a Wheatstone bridge operating on 1000 c.p.s. current. Alternatively the resistance thermometer can be incorporated in an oscillating circuit. In either case the indications are transmitted to a cathode-ray oscillograph, whose readings are recorded photographically. The procedure used for calibrating the plug is described in some detail; the calibration is more difficult when an oscillating circuit is used, but the sensitivity of this is greater than that of the Wheatstone bridge circuit. A study was made of the delay between the attainment of max temperature in the engine and its registration by the instrument. Test results are given showing the temperature on compression in a diesel engine and also the temperatures attained in the combustion space of a spark ignition engine prior to ignition; the latter results form part of a series of experiments on cold starting. For this purpose one spark plug of a multicylinder engine was replaced by the temperature measuring plug. Measurement of temperature on compression, with and without the introduction of fuel, enabled the richness of the vapour in the combustion space to be determined. A method for measuring the temperature of surfaces within an engine by means of a resistance thermometer consisting of a fine film of gold on aluminium oxide is also described. V. B.

1221. New Petter–Fielding Horizontal Engine. Anon. *Gas Oil Pwr.*, 1947, **42**, 172.—This four-stroke engine has a single cylinder of 8¼-in bore and 13¾-in stroke, and develops 40 b.h.p. at 500 r.p.m. A direct injection open-chamber combustion system has been adopted.

The camshaft, driving, and governor equipment are assembled in a single gearcase and mounted as a unit. Lubrication is from a plunger-type cam-operated pump. Fuel consumption is given as 0·42 lb per b.h.p. hr., and lub. oil as about 1% of this value. The weight of the engine, with standard flange-mounted fly-wheel, is 1·9 tons. H. C. E.

1222. Metrovick Progress. Anon. *Flight*, 1947, **51**, 552.—Details are given of endurance tests on the F2 series 4-jet engine. Two units have been made for the Saunders–Roe SR/A1, rated at 3300 lb per engine. Two more will power a modified Meteor with more than 7000 lb thrust. The endurance tests show up the combustion chambers as being the most quickly expendable component. I. G. B.

1223. Gas Turbine Combustion. E. A. Watson and J. S. Clarke. *Flight*, 1947, **51**, 552.—This is a review of the "can" type combustion chambers as developed by Messrs. Joseph Lucas and relates to the engineering problems rather than to the chemical. Comparisons are made with other oil-burning appliances and the development of the high heat-release chambers is traced. The aspects covered include entry swirl, swirl atomizers, torch ignition, fuels, and flame-tube temperature. I. G. B.

1224. General Survey of Gas Turbine Problems. M. Serruys. *Energie*, April 1947, **33**, 83–89.—A theoretical study of the thermodynamic aspects of the gas turbine.
G. P. K.

1225. Marine Gas Turbines. A. Meyer. *Motor Ship*, July 1947, **28**, 146.—The article is Dr. Meyer's reply to questions raised in a previous lecture. He gives further details of the "comprex"; deals with the range of power of the open-cycle process; compares the steam and air turbines; the time of starting up a gas turbine and the power necessary; ceramic blades; D.C. versus A.C.; electric heating; materials.

On the subject of combustion he describes the Brown Boveri refractory-lined chamber, with the following distinctive features: (*a*) Removable refractory element; (*b*) Air supply control in the secondary zone; (*c*) Stub pipes for good mixing; (*d*) vertical firing with good expansion arrangements; (*e*) Springing to reduce vibration stresses in main ducting joints.
I. G. B.

1226. An Internal-Combustion Unit and Gas Turbine. R. B. Neilson. *Gas Oil Pwr.*, 1947, **42**, 173–178.—A proposed new engine consists of a reciprocating unit in which the gas after combustion is not allowed to expand until it reaches a gas turbine. The combustion piston is held stationary in the cylinder until combustion is complete, and the exhaust gases then pass to the turbine by movement of a control piston operating in the same cylinder.

Compressed air at 300 p.s.i., directed into the turbine, is used for starting, and subsequent operations are as follows: With the main shaft rotating, air is delivered to the cylinder and compressed by the combustion piston, which remains stationary at the top of its travel whilst fuel is injected and combustion occurs. The control piston then recedes from the combustion piston to uncover the delivery ports, and the burning gases are delivered through an orifice, which defines the combustion volume, until the control piston returns to its original position, closing the delivery ports and cutting off the fuel supply. At this point the combustion piston recedes to admit scavenging air and to fill the cylinder with air for the next cycle.

The fuel valves are open during approximately 200° of shaft angle, so more fuel is consumed per cycle of operation than with an ordinary I.C. engine, and more power can be developed in a unit of given size.

It is suggested that suitable metals would include nickel–iron for the cylinder liner and nickel-chrome steel for the turbine wheels, which would have blades of stainless steel. The surfaces would be lubricated by compounded oils and colloidal graphite.

It is claimed that the advantages of this engine are: (1) The power–weight ratio is high; (2) High speeds can be produced with a turbine of relatively small space; (3) Thermal efficiency should be high; (4) Starting can be accomplished easier than on a conventional oil engine.

The text is illustrated by four figures.
H. C. E.

1227. Bearing Studies. Anon. *Rev. Inst. Franç. Pétrole*, 1947, **2**, 108–122.—This is the first report of a sub-committee, appointed by the Automotive Engine Committee of the National Centre for Scientific Research to make a study of the strength of main and connecting rod bearings. The report covers the enumeration of the various parameters concerned in this problem, the definition (with photographs) of terms used to indicate engine-bearing faults, and the establishment of a method for determining the limiting wear factor, particularly in the case of connecting-rod bearings. The expression $\sqrt{pV^3}$ is considered as being the most suitable form of wear factor (p = mean pressure, V = sliding velocity of the bearing with respect to the shaft). A method for the calculation of this factor is described and typical values for various types of machines are listed. A comprehensive specimen data sheet for bearings is included and the co-operation of automobile engineers both in France and abroad is asked in the compilation and return of such sheets.
V. B.

1228. Thornton Aero Engine Research Laboratory. Anon. *Engineer*, 1947, **183**, 360–362.—To keep fuel and oil quality in step with rapid war-time development in aero engines, the Thornton Aero Engine Research Laboratory was built during the war at Thornton-le-Moors, Cheshire. The laboratory was on loan to the Ministry of

Aircraft Production from 1942 until recently, when it was returned to the control of the company which built and operated it. The equipment includes nine full-scale single-cylinder test cells, and five test rooms for smaller engines. The cold room at − 40° can accommodate a complete main engine. Extensive sound-proofing results in a very low noise level. The photographic section includes an Arditron lamp, permitting photographs to be taken with an exposure down to half-a-millionth of a second, and used in gas turbine studies.

War-time research included investigations in improving the power, range, altitude performance, and reliability of military aircraft. Ring-sticking, sludge formation, cold starting, and gas-turbine combustion were all subjects of study, some still under investigation. Nickel–aluminium–cobalt coating for exhaust valves was found effective against high concentrations of tetra-ethyl lead in the fuel. Additive-type lubricating oils are tested in a standardized J.A.P. 250-c.c. air-cooled single-cylinder engine, which reduces the cost of testing considerably from that involved in the use of a "Hercules" single-cylinder unit. The article is illustrated with engravings of the main building, test beds, and photographic equipment. A. C.

MISCELLANEOUS.

1229. Emulsifiers. F. Appell. *Chim. et Ind.*, 1947, **57**, 341–346 (see Abstract No. 876/47).—This illustrated survey of industrial emulsifying equipment is concluded by an account of homogenizers, both valve and other types, impact emulsifiers and emulsifiers in which use is made of both shear and impact action. The article includes short lists of the main manufacturers of emulsifiers, the principal French patents covering this field and a brief bibliography. V. B.

1230. Farm Manure Gas. I. Carré. *Chim. et Ind.*, 1947, **57**, 448–452.—Gas (containing 52–58% methane) is yielded by fermentation at 35–40° C and pH = 7·5 of mixed vegetable and animal matter. Useful gas yields are obtained from fermentation vats after an incubation period lasting from eight days to a month; the whole fermentation cycle lasting three months. The average total yield is 50–60 m^3 of gas (cal. val. 5500–6000/m^3) per ton of manure; this is equivalent to about 50 litres of petrol. Analyses are given of gases from various types of manure; the design of suitable fermentation vats and the costs of production are also discussed. V. B.

1231. L.P.G.—Supply and Demand Outlook. G. F. Benz. *Oil Gas J.*, 24.5.47, **46** (3), 92.—A review is given of the supply position for liquefied petroleum gas, together with the demand by gas utility companies and household purchasers.

Sales increased from 465,000 gal in 1926 to an estimated 1,425,000,000 gal in 1946, increase on 1945 being 33%.

As for supply position it is estimated that there are 14,400,000,000 gal per year of C_3 and C_4 hydrocarbons potentially available at gasoline and cycling plants and at refineries. Modified Fischer-Tropsch plants should add to the supply.

Transportation of the products in bulk is by tank-car, transport truck, pipeline, barge, or tanker. 4000 pressure tank-cars are already in service, more are being built and a 6700 ton dry-cargo ship is being converted for use. It is estimated that some twelve months will elapse before transport facilities are adequate.

Butane should command a higher price than propane, especially during the winter. Three figures illustrate the article. G. A. C.

1232. Oil Storage Depots on the G.W.R. Anon. *Engineer*, 1947, **183**, 388.—The Great Western Railway Co. has put into service the first of fourteen new oil storage plants, in connection with fuelling the locomotives now being converted to burn oil. This depot is at Swindon and consists of three 30 ft × 9 ft dia tanks, which can be filled from rail-cars, and discharged to locomotives, at 40 tons per hr. A stand-pipe and swing-arm are used for loading, the swing-arm being counterbalanced so that oil drains away from the mouth of the filling line when not in use. A. C.

1233. United Kingdom Petroleum Trade in 1947 (Details for April and the Four Months). Anon. *Petrol. Times*, 7.6.47, **51**, 535.—Details are presented of U.K. imports and

exports of crude oil and refined products for April and the first four months of 1947. Comparable details for 1946 are also presented. R. B. S.

1234. Revival of Europe's Petroleum Imports. Anon. *Pet. Press. Service*, May, 1947, **14** (5), 101.—The article gives a survey of the petroleum imports of fourteen European countries for 1938 and 1946. Total imports for 1946 have dropped 17% below those for 1938 which is mainly due to the large decrease in Germany's imports. Detailed information on the imports of crude oil, gasoline, kerosine, lubricants, gas oil, and fuel oil for the individual countries is given together with reasons for the various trends noted. In general, imports of crude oil have dropped for those countries which were affected by the war and suffered damage to refinery installations, etc. The increased use of vaporizing-oil for mechanized farming, the extensive consumption of diesel oil in road vehicles and coastal shipping and the rationing of petrol all have produced marked effects on the petroleum needs of the countries concerned. It is suggested that the European market for the petroleum industry should soon top the pre-war level and will continue to expand indefinitely. G. P. K.

1235. Petroleum's Place in Sweden's Post-War Economy. L. P. Stockman. *World Petrol.*, May 1947, **18** (5), 64–66.—Sweden is converting her economy from wood and coal to oil. During the war she was only able to import 1 million brl/year of oil, and wood was extensively used as fuel. Domestic coal production is 430,000 tons/year and pre-war imports were 8 million tons/year. The British coal position has caused this to be reduced. Oil-shale deposits are considerable, but poor in quality (5–6% hydrocarbon). This industry is being developed. Uranium is present in the deposits. In 1946 petroleum imports were 14 million brl against an average of 10 million for each of the three pre-war years when only one refinery was operating in Sweden. Another was completed last year and three more are envisaged. One of these will be erected quickly as the components (U.S. surplus) are already fabricated. It will consist of two distillation units (7200 brl/day charging stock) and two naphtha reformers (3000 brl/day charging stock). A catalytic cracker is also contemplated. F. S. A.

1236. German and Japanese Rockets. Anon. *Aeroplane*, 1947, **72**, 622.—Two types are discussed :—

(1) *DFS* 228*v*-1. Power plant—one Walter HWK 109–509 bi-fuel, liquid-cooled rocket motor, mounted in the fuselage. Power output: max. thrust 3300 lb at S.L.: 3630 lb at 40,000 ft. Spec. fuel consumption 182 lb/lb thrust.

(2) *Fuji Kokuki Oka*. 3-Type 4 MK 1 Model XX rocket motors mounted in the rear section of the fuselage. No figures given on thrust power. I. G. B.

BOOKS RECEIVED.

When the Oil Wells Run Dry. Walter M. Fuchs. Dover, New Hampshire: Industrial Research Service, 1946. Pp. 447 + xiv. $3.75.

The object of this volume is to present an integrated picture of the subject of oil, giving social, political, and scientific facts, and to serve as a handy reference book to the past, the present, and the future.

The Petroleum Almanac. New York: National Industrial Conference Board, 1946. Pp. 420 + vii.

A compilation of statistical data relating to petroleum, its production, transport, refining, marketing, and distribution, its utilization, finance, labour, and its taxation, price, value, and other data. While the numerous tables relate mainly to the United States, there is much data on world production, etc.

British Petroleum Equipment. London: Council of British Manufacturers of Petroleum Equipment, 1947. Pp. 402 + xlvii. 10*s.* 6*d.*

One of the principal objects of the Council of British Manufacturers of Petroleum Equipment is to make known the fact that there is a large section of British industry engaged in manufacturing equipment for the oil industry. The present publication is devoted to this object and is in two sections. The first of these deals with membership of the Council, the firms being listed alphabetically and also classified in accordance with their products. The second, or catalogue, section is made up of announcements of individual firms, giving illustrations and information regarding specific pieces of plant or equipment.

L'Epopee du Petrole (The Epic of Petroleum). Pierre M. Edmond Schmitz. Paris: R. Pichon and R. Durand-Auzias, 1947. Pp. 223 + x.

Intended to give a comprehensive picture of the petroleum industry from 1859 to 1918, the book includes chapters on :—

The Industry prior to 1880;
Refining Processes;
The Chemistry of Petroleum;
and the work of Gustav-Adolphe Hirn and Joseph-Achille Le Bel.

The author is mainly interested in the development of the industry in Europe. He concludes with a chapter on the general aspect of the industry, and foresees that a far closer alliance between the refining and chemical industries is necessary before any real progress can be made.

La Economia del Petroleo en Colombia. A. E. Ospina-Racines. Bogota: Editorial Antena Ltda, 1947. Pp. 191.

This book is largely composed of articles previously published over the last few years, some in a South American financial journal. It covers legal, economic, and technical aspects of the petroleum industry in Colombia, the sequence being somewhat disjointed. The accent is on production and its value to the country, and a considerable amount of statistical information is presented. The last chapter, for no apparent reason, is devoted to O.N. A. C.

Bulletin de la Société des Naturalistes de Moscou. Nouvelle Série, Tome LI, Section Géologique, Tome XXI, (1946).

This volume (in six parts), devoted entirely to geological articles, includes the following: "The Devonian in Bashkiria and the Prospect of Oil Occurrence Therein" and "Tectonics of Salt Uplifts in the Dnieper–Donetz Depression." The papers are in Russian, but each has a summary, of some length, in French or English. V. B.

Voprosui Geologii i Razrabotki Neftyanuikh Mestorozhdenii Srednego Povolsh'ya. (Problems of the Geology and Development of Petroleum Deposits of the Middle Volga Region.) By V. G. Vasil'ev. Moscow–Leningrad, 1946. Pp. 172. 10 rubles.

This is a compilation of results, hitherto unpublished, obtained in 1940–41. After a short introductory section dealing with the geology and development of the region, the remainder of the book is devoted to an account of petroleum production in the area under discussion and the problems associated therewith. V. B.

Geologiya i Neftenosnost' Russkoi Platformui i Embui. (The Geology and Occurrence of Petroleum in the Russian Shelf and the Emba Region.) Moscow–Leningrad, 1946. Pp. 248. 12 rubles 50 kopeks.

This publication consists of a collection of twelve articles, by various authors dealing with work carried out during and immediately preceding the war. The book has been compiled by the All-Union Scientific Research Institute for Petroleum Geology and Development, an account of whose work during the war years forms the subject of the first article. The remainder deal with the petroleum geology of the regions mentioned and with petroleum production in this area. V. B.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	326 A
Geophysics and Geochemical Prospecting	328 A
Drilling	329 A
Production	330 A
Oilfield Development	334 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	335 A
Cracking	335 A
Metering and Control	335 A
Refining Patents	335 A
PRODUCTS.	
Chemistry and Physics ...	340 A
Analysis and Testing	343 A
Lubricants	346 A
Special Hydrocarbon Products	347 A
Derived Chemical Products ...	347 A
Miscellaneous Products ...	347 A
ENGINES AND AUTOMOTIVE EQUIPMENT	347 A
MISCELLANEOUS	348 A

AUTHOR INDEX.

The numbers refer to Abstract Numbers.

Amott, E., 1289
Andresen, K. H., 1277
Anes, M. R., 1309, 1316
Arnold, J. C., 1289
Aston, J. A., 1316
Aston, J. G., 1309
Asty, J., 1240
Axe, W. N., 1289

Baker, R. H., 1296
Baral, W. J., 1289
Beach, J. Y., 1328
Beebe, R. A., 1290
Beerbower, A., 1289
Bell, M. F., 1329
Best, D. M., 1251
Biscoe, J., 1290
Blau Jr., C. M., 1289
Blaker, R. H., 1335
Bobo, R. A., 1264
Bogart, L. G. V., 1289
Bolinger, J. C., 1289
Bond, D. C., 1289
Brian, T. P., 1289
Brinkley, S. R., Jr., 1295
Brockway, L. O., 1312
Brown, C. L., 1289
Burdett, R. A., 1318, 1319
Burk, R. E., 1289
Burns, W. W., 1283
Burrows, L. A., 1289

Campbell, D. L., 1289
Cantrell, T. L., 1289
Capshaw, E., 1263
Carlson, G. J., 1289
Carver, E. K., 1334
Cavanagh, R. S., 1250
Cerveny, W. J., 1326
Chenicek, J. A., 1289
Claypool, R. M., 1251
Coley, J. R., 1298
Corson, B. B., 1326
Cosby, J. N., 1297
Cozzens, F. R., 1257, 1269
Craft, W. S., 1289
Crouch, J. O., 1281
Crowley, J. A., Jr., 1289
Culmer, T. W., 1289

Dale, O. O., 1268
Danforth, J. D., 1289
David, L. R., 1238
Dean, P. C., 1279
Deegan, C. J., 1239
Dietrich, M. A., 1289
Doumani, T. F., 1289

Egloff, G., 1241
Ellenberger, F. W., 1277
Evans, L. P., 1289
Evans, T. W., 1289

Falkins, H. O., 1289
Feiser, L. F., 1306
Field, J. H., 1288
Fink, H. L., 1309, 1316
Fischer, H. G. M., 1289
Flood, L., 1261
Foster, A. L., 1286, 1337
Francis, A. W., 1301
Frey, F. E., 1289, 1309

Gleason, A. H., 1289
Goldstein, R. F., 1338
Goldstein, T., 1325
Gordon, B. E., 1319
Gorin, M. H., 1289
Groote De. M., 1289
Grosse, A V., 1289, 1321
Grubb, H. M., 1289

Hachmuth, K. H., 1289
Hall, H. J., 1289
Hanson, T. K., 1315
Hastings, S. H., 1330
Heaton, W. B., 1315
Heigl, J. J., 1329
Hepp, H. J., 1289
Hill, H. M., 1302
Hinckley, J. A., Jr., 1326
Hinden, S. O., 1321
Hoerger, E., 1335
Holligan, P. T., 1341
Holroyd, R., 1289
Hornbacher, H. G., 1332
Horton, A. W., 1305
Hudson, N. L., 1343
Huff, L. C., 1289
Huffman, H. C., 1289, 1292, 1293, 1294
Hughes, E. G., 1289
Hughes, R. V., 1275
Hume, G. S., 1237
Hummel, F. E., 1254

Ibach, G. A., 1289
Ipatieff, V. N., 1308

Johnsen, S. E. J., 1331
Johnson, G. C., 1291
Jones, E. N., 1265, 1266, 1267
Jones, L. C., Jr., 1318
Jones, P. J., 1274

Kahn, A., 1327
Karabinos, J. V., 1304
Karle, J., 1312
Kassel, L. S., 1289
Kats, J. J., 1300
Kaveyev, M. S., 1243
Kay, W. B., 1311
Keeser, B., 1289
Kelly, E. J., 1289
Kent, J. W., 1328
Kinnsberg, I. H., 1289
Knudsen, H. L., 1314
Komarewsky, V. I., 1298
Kuck, J. F. R., Jr., 1304

Lake, G. R., 1289
LeRoy, D. J., 1327
Lewis, C. F., 1251
Lieber, E., 1289
Linford, H., 1289
Linn, C. B., 1289
Lloyd, L. E., 1332
Lochte, H. L., 1303
Love, R. M., 1320

McCulloch, T. B., 1289
McClain, H. M., 1276
McCoy, P. E., 1289
McDaniel, E., 1252
McNab, J. G., 1289
Manuel, R. W., 1289
Marsden, S. S., 1313
Martin, D., 1277
Mattox, W. J., 1289
Mayland, B. J., 1289
Mayo, F. R., 1299, 1300
Mennie, D. B., 1259
Merwin, W. J., 1289
Miles, S. H., 1333
Miller, R. J., 1289
Morgan, J. D., 1289
Morris, J. R., 1289
Morris, R. C., 1315
Morse, R. A., 1278
Morway, A. J., 1289
Munday, J. C., 1289
Mysels, K. J., 1313

Naragon, E. A., 1289
Neilson, R. F., 1259
Nelson, W. L., 1288
Noyes, R. M., 1335

Odell, W. W., 1289
O'Leary, C. M., 1248
Oliver, G. D., 1294

Packie, J. W., 1289
Padgett, A. R., 1330
Padgett, J. C., 1256
Panchenkov et al., G. M., 1287
Payne, J. W., 1289
Pedersen, C. J., 1289
Peel, D. H. P., 1289
Peters, E. D., 1335
Peterson, L. P., 1260
Pickard, P. L., 1303
Pines, H., 1308
Poole, R., 1289
Price, C. F., 1298
Prutzman, P. W., 1289
Putnam, S. T., 1306
Pyke, R., 1337

Ray, F. E., 1289
Records, E. H., 1289
Reed, P., 1239
Reeves, E. D., 1289
Richards, A. R., 1322
Rippeteau, W. L., Jr., 1289
Rose, J. R., 1289
Ross, W. E., 1289
Routson, W. G., 1289
Rowland, C. S., 1297
Rupp, W. H., 1289
Russell, A. S., 1310
Rust, F. F., 1289
Rutherford, J. R., 1289
Ryder, H. M., 1280

Savoy, M., 1289
Savoy, M. G., 1299
Schaad, R. E., 1289
Scheeline, H. W., 1289
Schonberg, J. R., 1289
Schrader, L. W., 1289
Schuetz, R. D., 1296
Schussler, R. W., 1297
Schwartz, M. L., 1289
Sensel, E. B., 1289

Seyfried, W. D., 1330, 1330
Showalter, J. C., 1289
Shchelkachev, V. N., 1263
Shepherd, M., 1317
Shoemaker, D. P., 1335
Simpson, T. P., 1289
Singleton, H. M., 1320
Smith, G. H., 1313
Smith, H. G., 1289
Smith, W. R., 1290
Sparks, W. J., 1289
Spitser, R., 1293
Stokes, J. J., Jr., 1310
Stout, C. R., 1273
Sullivan, A. P., 1289
Swerdloff, W., 1289
Tate, C. C., 1289
Taylor, E. C., 1323, 1324
Teter, J. W., 1289
Thacker, C. M., 1289
Thomas, C. L., 1289
Thompson, R. B., 1289
Thorner, M. B., 1289
Tiratsoo, E. N., 1242
Todd, S. S., 1292, 1294
Tooke, J. W., 1316
Tresder, R. S., 1289
Tucker, E. B., 1289
Tyson, C. W., 1289
Vaughan, W. B., 1289
Wachter, A., 1289
Waddington, G., 1292
Wagner, C. D., 1325
Wagner, C. R., 1289
Wagner, E. C., 1333
Walters, E. L., 1289
Waterman, L. C., 1289
Waters, J. F., 1271
Waser Van, J. R., 1334
Weiner, H., 1307
Wells, N. C., 1256
Wendell, C. B., 1290
White, J. U., 1329
Whitmore, F. C., 1297
Williams, N., 1244, 1247
Wilson, G. M., 1249
Wilson, J. A., 1272
Wingrove, B. R., 1289
Winning, C., 1289
Wolfrom, M. L., 1302
Workman, A. B., 1289
Wright, B. O., 1289
Young, D. W., 1289
Young, W. S., 1323, 1324
Yuster, S. T., 1259, 1278
Zimmerman, G. B., 1289

Oilfield Exploration and Exploitation.

Geology.

1237. Results and Significance of Drilling Operations in the Athabaska Bituminous Sands. G. S. Hume. *Trans. Canad. Inst. Min. metall.*, 1947, 298–324.—The Steepbank area, 22 miles north of Fort McMurray, has an average of 11·96% of bitumen over 945 acres, with a ratio of bituminous sand to overburden of 2·5 to 1. The Horse River area, where the Abasand Oils plant was erected, is not considered satisfactory for large-scale operations. The deposit as drilled contains about 4,350,000 brl of bitumen. 22 ft of clay intervenes between the sand and the limestone. The area north of Steepbank river has no value, but the west deposit averages 12·3% bitumen over 92 acres. An area 3 miles north of the mouth of the Muskeg River had good grade bituminous sand interstratified with much clay.

Twenty-two miles north of Fort McMurray on the west bank of the Athabasca River is the Mildred–Ruth Lakes area. The Waterways formation (Up. Devonian) consists of grey limestones and shales overlying anhydrite and salt beds. Clays of Lower Cretaceous age occur on top in addition to residual clays. The McMurray sands are bituminous and in places cross-bedded and lenticular, with interbedded clay and shales. There are lignite seams and plant remains. The bitumen impregnation occurs over a large area. There is some interfingering of the deltaic deposits with marine shales, and some of the Lower Clearwater shales are contemporaneous with the Upper McMurray. In one boring the bituminous sands were 229 ft thick. The Clearwater has not been recognized in the Mildred–Ruth Lakes area, but is 275 ft thick at Boiler Rapids, and is overlain by the Grand Rapids formation. The McMurray–Waterways contact undulates and anticlines and synclines occur, mostly due to structure, but modified by erosion. The broadet structural features of the limestone are probably displayed in the McMurray. Correlation of the bituminous beds is not always possible. Undoubtedly the limestone surface had some relief at the time of Cretaceous deposition. The McMurray thickens westwards in this area. The Devonian undulations may not be of tectonic origin, but may be due to changes in the underlying anhydrite and salt beds.

Generally, the lower part of the deposits is better impregnated than the upper part, and all bituminous beds are in the lower half. The amount of clay is variable. Deep, rich sands under thick overburden have no value. Usually the coarser sands have the better bitumen impregnation. As much as 83·2% of bitumen has been found, and in many beds it exceeds 50%. There is bitumen with sand in it. In the bitumen beds there is 9–26% of water, but in the bituminous sand beds there is little water. Temperature readings have been found to decrease with depth. The bitumen beds are interstratified with bituminous sands, and the thickest bitumen bed was 21 ft.

Bitumen seepages have been found, and bitumen appears to seep upwards through almost vertical tubes along with clear water. Apparently they arise from concealed beds of bituminous sand. These may explain the formation of the bitumen beds found in the McMurray, the latter having been formed during McMurray deposition. The bitumen beds suggest that the material must have been formed near at hand. The bitumen cracks at abnormally low pressures and temperatures as compared with residuums. A source to the west in dark marine shales seems possible. Evidence of shore-lines is provided by coals and conglomeratic beds. The sand grains have been

found to be water-coated inside the "oil," and the grains may have been oil-coated during deposition, and the oil not migrant into the sand.

The Mildred–Ruth Lakes deposit contains an enormous amount of bitumen. On the basis of some borings an acre might contain 330,000–350,000 brl of bitumen, and it is likely that an area of 120 acres could be selected for supporting a 10,000 brl/day plant for 15 years.

In the boring holes over 200 ft deep have normally been completed in 4–5 days, and core recovery in seventy holes averaged 95·3%. The poorest recovery was 83%.

G. D. H.

1238. How Fossil Fish Remains have been used in Pacific Coast Stratigraphy. L. R. David. *Petrol. Engr*, May 1947, **18** (8), 104.—Most oil-pools are believed to have been laid down in marine basins and the study of fossil remains associated with oil deposits is therefore expected to yield some information regarding the conditions under which these oil deposits came into existence. Many illustrations of fossils found in Pacific Coast formations are presented and their value in developing the Historical Geology and Stratigraphy of the area are discussed. Twelve references to papers on Palaeo-ichthyology are appended.

R. B. S.

1239. Venezuela No. 2 Oil-Producing Nation. C. J. Deegan and P. Reed. *Oil Gas J.*, 28.12.46, **45** (34), 236.—Currently Venezuela produces about 1,100,000 brl/day, two-thirds being from the Maracaibo basin. Two-thirds of the drilling activity is in Eastern Venezuela. Reserves are estimated to amount to 8,000,000,000 brl.

In Venezuela the producer has a much higher indirect capital investment per brl of daily production than in U.S.A.

The sediments of the Eastern Venezuela basin wedge out against the Guayana shield. The basin is subdivided by a line through the igneous rocks on the Paraguana Peninsula and at El Baul, the parts being the Orinoco basin and the Apure or Barinas basin. On the east side of the Maracaibo basin the fields are structural and stratigraphic traps. Prolific Cretaceous limestone production has been found west of the Lake in the La Paz and Mara fields. La Paz also produces from Eocene sands and the Guasare sands, shales and limestones at depths of 2000–3000 ft.

In Eastern Venezuela wells drilled too far south find tar and dead oil. Most of the fields produce from the Oficina sands of Miocene age. The Greater Oficina area fields are of the fault-block type. They lie on the southern flank of the basin. The reservoir rocks are more or less broad sheets of sand dipping north and northeast, trapping being by faults and pinch-outs at depths of 4000–7000 ft. The Greater San Joaquin area to the north produces from steeply dipping beds which are frequently faulted. The depths range 6000–11,000 ft. Jusepin produces from three Miocene sand lenses. In the Greater Jusepin area sediments are believed to have been derived from the Northern Range. Jusepin also produces from truncated southwest-dipping Oligocene beds.

Quiriquire produces from Pliocene and Pleistocene beds deposited on truncated Cretaceous and Tertiary beds. Las Mercedes produces from the Miocene La Pascua sands. One well has been completed in the Cretaceous.

There is folding along a southwest to northeast line through the Greater San Joaquin area.

G. D. H.

1240. French Geologists Look to Southwestern Region in Search for More Oil. J. Asty. *Oil Gas J.*, 28.12.46, **45** (34), 259.—In 1939 natural gas was found in a well at St. Marcet, and in 1940 oil was obtained. Geological and geophysical work was carried out in a zone at the foot of the Pyrenees.

In 1944 gas production reached 7,063,000 cu. ft./day.

Considerable efforts are being made to train personnel and to acquire equipment for proper oil investigations in France and her colonies. A five-year programme backed by 55,000 million francs has been arranged.

Gas has been found on the St. Marcet and St. Martoury structures, and there are encouraging signs of gas on the Plagne structure. Gas output is limited by lack of absorption plant and distributing lines, but an output of 35–42 million cu. ft./day is planned.

G. D. H.

1241. China's Potential Oil Resources Large. G. Egloff. *Oil Gas J.*, 28.12.46, **45** (34), 243.—Oil exploration in China has been limited mainly to a few areas with seepages

and favourable structures. These extend along a 2000 miles arc from Sinkiang through Kansu, Szechuan, and Shensi provinces. Reserves of about 1,620,000,000 brl have been found. The known oil-bearing areas are the Tsungari, Tarini, North Kansu, North Shensi, Szechuan, North Manchuria, and East Jehol basins.

Poor communications are hindering exploration and exploitation.

The Yuman (Laochionmiao) field was opened in 1939 in northwest Kansu. In 1944 the output was 3000 brl/day. Seepages are present where a river cuts the crest of an anticline. Production was found at 200–550 ft, but there has been deeper development at 1300–1400 ft. Oil has also been found at 1638 ft. Up to February 1945 the cumulative production was 1,379,000 brl, 1,347,000 brl being from the 1300–1400 ft sands. The oil has 15% of wax. The field has two refineries. In 1945 the twenty-six wells were giving 1500–2200 brl/day. The proven area of 600 acres may have 45,000,000 brl of oil.

In the south and southeast of the Red Basin of Szechuan there are about 100 anticlines which generally run northeast to southwest. There are coal deposits, and brine wells 2000–3000 ft deep which have sometimes given a little oil and gas. The oil obtained at Mioerhkow has little sulphur, and gives only 2% of straight-run gasoline. The gas is from the Trias. One well gives 500,000 cu. ft./day. The Tzyeliusing gas field is perhaps 2000 years old. It appears that drilling at Wu Su in northwest Sinkiang found 49–52° A.P.I. oil at depths of about 4800 ft in association with large gas flows. There are oil seeps at a number of points.

Some wells on the southern edge of the Tsungari basin in north Sinkiang are reported to have given 75–225 brl/day. The Tarini basin of southern Sinkiang has seepages, but there has been no organized prospecting. Small oil pools are known in North Shensi, and some oil has been found in the north Manchuria and the East Jehol basins. An asphalt deposit is known in the Turfan basin of east Sinkiang. The Tsaidam basin appears to have oil possibilities and other possible areas are northwest Kueichow, western Yunnan, and Kwangsi.

Seven oil-bearing structures are known in western Formosa. These are near Byoritsu, and 143 of 224 wells produced gas or oil from depths less than 3275 ft. Oil production has averaged 80 brl/day, and gas production about 7,000,000 cu. ft./day. Shukkoko is the main field. The crude is a wax-bearing naphthene-intermediate base oil.

In 1939 the Fushun (Manchuria) oil shale was providing 2,000,000 brl/day of oil. The shale reserve is 5,500,000,000 tons, equivalent to 2,109,000,000 brl of oil. The Shensi oil shale reserve of 5,000,000,000 tons is equivalent to 852,000,000 brl of oil.

China's coal reserves are placed at 240,000,000,000 tons, mainly in Shensi and Shansi provinces. G. D. H.

1242. Oil in Japan. E. N. Tiratsoo. *Petroleum*, 1947, **10**, 80.—A brief survey of Japanese oilfields and their geology and structure is given together with statistics regarding crude oil production therefrom. Mention is also made of the work carried out to produce synthetic fuel.

Japanese resources of indigenous crude oil are small and the proved reserves are dwindling. This can be largely attributed to unbalanced exploitation and to neglect of geological and geophysical methods of exploration. If such systems were to be adopted, they might yet lead to the discovery of sufficient petroleum to meet the country's present-day requirements. F. W. H. M.

Geophysics and Geochemical Prospecting.

1243. About Certain Geochemical Processes in the Permian Deposits of the Sarabikulovo Oil Pool. M. S. Kaveyev. *Comptes Rend. Acad. Sci. URSS*, 1947, **55**, 425 (in English).—The oil accumulations discovered in the vicinity of Sarabikulova village, Shugurovo district, are mainly confined to the top of the Ufa series of the Permian deposits. Based on detailed analyses of well waters and gases, the geochemical processes responsible for the particular features of the deposits of the region are described. G. H. B.

Drilling.

1244. Drilling Costs in Rangely Field. N. Williams. *Oil Gas J.*, 26.4.47, **45** (51), 150.—An account is given of the methods used to reduce drilling costs in the Rangely field of Northwest Colorado. A decrease of 25% in drilling costs has been achieved. R. B. S.

1245. Casing and Wire Rope. Anon. *Oil Wkly*, 12.5.47, **125** (11), 42.—The future requirements of well casing and wire ropes to withstand the loads and stresses imposed by drilling wells of great depth is discussed. R. B. S.

1246. Drilling Barges for Lake Maracaibo. Anon. *Oil Wkly*, 5.5.47, **125** (10), 18 (*International Section*).—The design and construction of drilling barges for use 15 miles offshore on Lake Maracaibo, is briefly described. R. B. S.

1247. Self-Propelled Cementing Barge for Offshore Operations. N. Williams. *Oil Gas J.*, 12.4.47, **45** (49), 84.—The layout and manipulation of cementing barges designed for use at offshore locations along the Louisiana and Texas Gulf Coast are briefly described. R. B. S.

1248. Torque Converter Drives for Oil-well Drilling Rigs. Part I. C. M. O'Leary. *Oil Wkly*, 21.4.47, **125** (8), 42.—A detailed discussion is given of the design and operation of torque converter drives and the advantages resulting from their use in oil-well drilling rigs.

In this part the following are discussed: (1) the blading system; (2) reaction blades; (3) operation of converter; (4) efficiency curve; (5) match engine and converter curves; (6) measure of horse-power loss; (7) gearing; (8) lengthening of equipment life by use of torque converters; and (9) speed ratios. R. B. S.

1249. Drill-Pipe Handling. G. M. Wilson. *Oil Wkly*, 10.3.47, **125** (2), 60.—A brief description is given of a small drill-pipe carriage and inclined track system which simplifies the laying down or picking up of drill-pipe or casing. R. B. S.

1250. Non-Destructive Testing of Drill-Pipe. R. L. Cavanagh. *Oil Wkly*, 10.3.47, **125** (2), 42.—A brief description is given of an instrument suitable for predicting the failure of drill-pipe whilst running the string in or out of the hole, without interfering with normal drilling operations. The instrument consists of a cyclograph test coil, through the field of which the drill-pipe passes: this causes core-losses which control the output of an oscillator. These core losses are affected by the magnetic and electrical properties of the drill-pipe which, in turn, depend on their physical characteristics. Hence the output of the oscillator, which can be recorded by the use of a cathode-ray tube, is an indication of the physical condition of the drill-pipe.

Some field tests with this instrument are briefly described and some graphs of cyclograph readings obtained by these tests are shown. At present the work is only in the experimental stage and much work has to be done to perfect an instrument sufficiently sensitive and economical for practical use. R. B. S.

1251. Torque Strength of Oil-Well Tubing and Drill-Pipe. D. M. Best, C. F. Lewis, and R. M. Claypool. *Oil Wkly*, 14.4.47, **125** (7), 44.—The author derives the following equations for making a field determination of the torque to which a drill-pipe or tubing string is subjected:

$$S_{s\,max.}^2 = S_s^2 + \tfrac{1}{4}S_t^2; \quad n = \frac{S_s l}{E_s C 2\pi},$$

where $S_{s\,max.}$ = maximum allowable shear stress in p.s.i.; S_s = shear stress due to torsion in p.s.i.; S_t = tensile stress in p.s.i.; n = number of revolutions of pipe end (with one end fixed) when the shear stress is equal to S_s; l = length of pipe in inches; E_s = modulus of rigidity; and C = outside radius in inches.

This equation can be used on a pulling job (*e.g.* pulling a packer) when the maximum allowable tensile pull is insufficient: the amount of straight tensile pull to be applied to the tubing (S_t) is first decided upon: with a knowledge of $S_{s\,max.}$ for the particular

tubing installed the maximum allowable shear stress due to pure torsion (S_s) can be determined from the first equation. Using this value of S_s and knowing E, and C the value of n can then be calculated: if l is taken as 12,000 the n will be the maximum allowable turns of backlash which can be allowed per 1000 ft of tubing.

In the field the pull equivalent to S_s is taken on the pipe and the table rotated a number of turns in the desired direction equivalent to n. If the tubing then still fails to lift the clutch is released and the number of revolutions of backlash are counted: if these are less than n the deficit may be considered to be due to thread make-up. The procedure is repeated until n revolutions of backlash are obtained. If the string still cannot be pulled it is advisable to try other fishing methods for recovery to avoid a twist-off.

The author also discusses the assumptions used in the calculations and the modifying factors which should be applied in using the equation. A numerical example is also worked out. R. B. S.

1252. Proper Care of Wire Line Increases Life. E. McDaniel. *Petrol. Engr*, April 1947, **18** (7), 88.—A few hints are given concerning the installation and lubrication of wire lines, and the cutting back and changing of wire-line ends. R. B. S.

Production.

1253. Comparison of the Basic Parameters of Similitude in Underground and Sand-Free Pipes' [smooth-bore cylindrical tubes] Hydraulics. V. N. Shchelkachev. *Compt. Rend.* (*Doklady*) *Acad. Sci. URSS*, 1946, **54**, 673 (in English).—Five dimensionless parameters, including the Reynolds number, Leibenson's percolation number, the Darcy–Poiseuille number and a derivative of the Froude number are formulated and applied to the study of some problems in underground hydraulics involving fluid percolation through porous media. An expression is derived for the Reynolds number of such a system and two equations for the generalized law of percolation developed. From these the well-known formulæ of Poiseuille, Blasius, and Prandtl for fluid flow through tubes, and the percolation laws of Darcy, Smreker, and Krasnopolsky can be deduced for particular values of the appropriate constants. A convenient equation for the evaluation of experimental data on percolation flow is given from which deviations from the Darcy percolation law may readily be detected. G. H. B.

1254. Selection of Multi-cylinder Gas Engines. F. E. Hummel. *Petrol. Engr*, April 1947, **18** (7), 120.—The factors affecting the selection of multi-cylinder gas engines for oil-well pumping units are discussed in some detail. R. B. S.

1255. Formation Testing and Testing Equipment. J. C. Padgett. *Oil Wkly*, 24.3.47, **125** (4), 18.—The various methods of formation testing and developments in this field are briefly reviewed. Various auxiliary equipment is also necessary to ensure maximum safety and proper testing procedure. In this connexion the following equipment is discussed: (1) control heads; (2) two-way circulation valves; (3) by-pass chokes; (4) equalizing by-passes; and (5) safety joints. The following types of packers are also described: (1) cone packers; (2) sleeve-type packers; (3) hook-wall packers; and (4) various combinations of these. Packer anchors and pressure and temperature-recording devices for testing purposes are also discussed. R. B. S.

1256. Chemical Treatment of New and Producing Wells. N. C. Wells. *Petrol. Engr*, April 1947, **18** (7), 90.—The conditions for which chemical methods of well cleaning are more satisfactory than other methods are discussed. The harmful materials which may accumulate around a well bore are: (1) silt; (2) clay; (3) wax (asphaltenes, paraffins, etc.); (4) mud cake; (5) hydrated bentonic shale; (6) calcareous and other scales; and (7) stray cement: these are also briefly discussed. R. B. S.

1257. Unsalvaged Casing Menace in Abandoned Stripper Wells. F. R. Cozzens. *Oil Wkly*, 7.4.47, **125** (6), 58.—The detrimental effects caused by abandoning stripper wells without properly salvaging casing and plugging off formation are described. R. B. S.

1258. Selecting Artificial Lift Equipment. J. H. Field. *Oil Wkly*, 14.4.47, **125** (7), 49.—The factors necessary for consideration in selecting artificial lift equipment are discussed together with the comparative advantages and disadvantages of the following systems: (1) sucker-rod pump with conventional type pumping units; (2) hydraulic pumps; (3) submersible centrifugal pumps; (4) flow valves; (5) sucker-rod pumps with hydraulic head systems; and (6) sucker-rod pumps with rod-line power.
R. B. S.

1259. Recent Experiments in Air–Gas Drive Recovery. D. E. Menzie, R. F. Neilson, and S. T. Yuster. *Oil Wkly*, 28.4.47, **125** (9), 34. (*Paper presented at the 10th Annual Secondary Recovery Conference, School of Mineral Industries, Pennsylvania State College.*)—See Abstract No. 807 (1947).

1260. Inventory of Gas-Drive Projects in North Texas. L. F. Peterson. *Oil Gas J.*, 12.4.47, **45** (49), 91. (*Paper presented before Southwest District Division of Production, A.P.I., Fort Worth*, March 1947.)—A brief review is given of gas injection operations in the Panhandle and North Central Texas areas. R. B. S.

1261. Inventory of Gas-Drive Projects in West Texas and New Mexico. L. Flood. *Oil Gas J.*, 12.4.47, **45** (49), 94. (*Paper presented before Southwest District Division of Production, A.P.I., Fort Worth*, March 1947.)—Fifteen gas-injection projects in the West Texas–New Mexico area are reviewed. Brief mention is also made of proposed projects in nine other fields in the area. R. B. S.

1262. Casing-head Gas Conservation by Reinjection. Anon. *Oil Wkly*, 12.5.47, **125** (11), 39—An account is given of the Continental Oil Company's plant in the Rincon field, Starr County, Texas, which produces butane and gasoline from the casing-head gas and returns the dry gas back to the subsurface reservoir. R. B. S.

1263. Gas Well Back-Pressure Testing. E. Capshaw. *Oil Wkly*, 10.3.47, **125** (2), 56.—The fundamentals of back pressure testing are discussed and methods are shown for calculating the absolute open flow and the deliverability of gas wells. R. B. S.

1264. Efficient Continuous Flow Gas Lift. R. A. Bobo. *Oil Wkly*, 17.3.47, **125** (3), 34.—Continuous flow gas-lift operations are discussed from a quantitative standpoint. A method is devised for determining the amount of useful work that is accomplished by the injected gas in a steady flow gas-lift system, and which is independent of that performed by the reservoir energy. A means of calculating the efficiency of gas lift from well inlet to well discharge is also shown, and the manner in which overall efficiencies in a closed, rotative recompression system may be computed is discussed. Finally, the theoretical sources of energy waste in lift operations are outlined and various factors warranting investigation are outlined. One reference is given.
R. B. S.

1265. Treating Artificial-Lift Wells with Mud Acid. E. N. Jones. *Oil Gas J.*, 12.4.47, **45** (49), 105. (*Engineering Fundamentals*, No. 281.)—The treatment of pumping and gas-lift wells with mud acid is briefly discussed. An example is given of a squeeze method which can be used on several types of wells without removal of any surface or subsurface equipment. R. B. S.

1266. Action of Mud Acids on Well Equipment. E. N. Jones. *Oil Gas J.*, 19.4.47, **45** (50), 137. (*Engineering Fundamentals*, No. 282.)—The effect of mud acid on cement behind the casing or in the hole, and on packer elements or liners is discussed.
R. B. S.

1267. Mud Acidization Before Squeeze Cementing. E. N. Jones. *Oil Gas J.*, 26.4.47, **45** (51), 185. (*Engineering Fundamentals*, No. 283.)—A method is suggested for cleaning the formation to remove mud prior to squeeze cementing for a water shut-off. The method consists of an acid treatment using a tail pipe installation. R. B. S.

1268. Thermo-Setting Plastics Effective in Well Repair. O. O. Dale. *Petrol. Engr*, May 1947, **18** (8), 90.—The advantages of plastics for selective plugging of wells is

reviewed: the procedure which should be adopted in these repairing operations is also outlined. R. B. S.

1269. Selective Shooting. F. R. Cozzens. *Oil Wkly*, 28.4.47, **125** (9), 53.—The advantages of selective shooting for increasing oil production are briefly discussed. R. B. S.

1270. New Oil-Well Shooting Method. Anon. *Oil Gas J.*, 12.4.47, **45** (49), 86.—A new oil-well shooting method which utilizes the "shaped charge" principle is briefly explained. Applying the basic principle that an explosive acts perpendicular to its surface, a shell was designed using cones as the shape for the shot. This design produces a breaking and shattering effect, rather than a pulverizing action as is experienced with a conventional shot. R. B. S.

1271. British Well Shooting Problems. J. F. Waters. *Oil Wkly*, 5.5.47, **125** (10), 26 (*International Section*). (*Paper presented before Institute of Petroleum, London*, Dec. 1945.)—See Abstract No. 539 (1946).

1272. Design and Operation of Swabs for Oil Wells. J. A. Wilson. *Petrol. Engr*, May 1947, **18** (8), 72.—The desirable characteristics of a swab are: (1) that it will fall as fast as the line is unreeled; (2) that it will pull a full load and give a maximum number of trips before requiring a change of cups; (3) that cups can be changed easily and speedily; (4) that it will pull both light and heavy loads without loss of fluid or disintegration of the cups; and (5) that it is unlikely to lose any of its parts in the well.

Four types of swabs are described and compared insofar as the above requirements are concerned. These four types are: (1) the fixed-ball swab; (2) the split-ball swab; (3) the expanding cup swab; and (4) the balloon-type swab. The procedures to be adopted in swabbing through casing and bringing in a well are also discussed. Finally, the cost of swabbing wells is outlined and swabbing practices which should be avoided are mentioned. R. B. S.

1273. Some Observations on the Problems of Cleaning Out Stripper Oil Wells. C. E. Stout. *Producers' Monthly*, May 1947, **11** (7), 13.—The decreases in well productivities are often due to many causes besides the fundamental cause of loss of reservoir energy. In the Pennsylvania Grade region some of the major causes are: (1) the accumulation of paraffin in the shot-hole and on the sand face; (2) the sloughing off of sand from the walls which gradually fouls the pumping equipment; (3) the caving and accumulation in the shot-hole of material from the open hole above the sand; (4) the failure of casing, allowing water to enter the well and the producing sand; and (5) the accumulation of salt on the walls of the well bore. Owing to this variety of causes of decreased productivity, no one method of cleaning out will work satisfactorily in all cases.

Tabulated data are presented which summarize the information obtained from 116 clean-out jobs in the Pennsylvania Grade region: these data are used as a basis of analysing the cost of cleaning out by various methods. The methods considered are: (1) open-shot methods; (2) tamped-shot methods; (3) heating methods—further subdivided into (*a*) carbide treatment; (*b*) steam treatment, and (*c*) electrical heating; and (4) cleaning out only.

The author concludes that owing to the high cost of cleaning out jobs, great care should be taken to select for cleaning only those wells which are likely to respond readily to treatment. This can be done by a careful study of a well's production history. R. B. S.

1274. Oil Production by Water. Part 18. Three Producing Units. P. J. Jones. *Oil Gas J.*, 19.4.47, **45** (50), 124.—The considerations involved in splitting reservoirs, as described in Part 17, are further discussed. The numbers of producing units into which a linear reservoir should be split depends on the ratio of strike to dip distances. If the reservoir is split into a series of comparatively small producing units large volumes of water will have to be produced to displace the recoverable oil and the system will be uneconomic. The considerations involved in determining the required number of wells are also discussed. R. B. S.

1275. Importance of Clay Studies in Water-Flood Operations. Part III.—Some Problems Created by Clays. R. V. Hughes. *Producers' Monthly*, April 1947, **11** (6), 10.—The effect of the properties of clays on secondary recovery operations are discussed insofar as they affect each of the following: (1) drilling; (2) sand interpretations; (3) selective shooting; (4) cleaning out; and (5) input water supply. Sixteen references are appended.

This paper concludes the series of three articles to which have been appended a total of 40 references. R. B. S.

1276. Practical Aspects of Water Flooding Outlined in Three Successful Projects. H. M. McClain. *Oil Gas J.*, 26.4.47, **45** (51), 152; *Petrol. Engr*, April 1947, **18** (7), 128; *Producers' Monthly*, April 1947, **11** (6), 31. (*Abridged version of paper presented at Annual Secondary Recovery Meeting, North Texas Oil and Gas Assoc, Wichita Falls*, March 1947.)—Details are given of the preliminary investigations and development of successful water-flood projects in North- and West-Central Texas. R. B. S.

1277. Selective Exclusion of Water in Input Wells. D. Martin, K. H. Andresen, and F. W. Ellenberger. *Oil Gas J.*, 19.4.47, **45** (50), 106; *Producers' Monthly*, April 1947, **11** (6), 18. (*Paper presented before Eastern District Division of Production, A.P.I., Pittsburgh*, April 1947.)—Water by-passing in secondary recovery operations can be caused by (1) variable permeability in sands giving rise to streaks of low oil saturation which will show a high relative permeability to water; and (2) cracks or fissures throughout the sand body which may be due to various natural and artificial causes. Recent advances in selective plugging of wells to prevent by-passing of the first type are reviewed.

Laboratory and field experiments on the use of colloidal dispersions (emulsions) of paraffin wax and of rosin as plugging agents are briefly discussed. They show that: (1) the emulsion must be stable: no coagulation due to pressure variations, aeration, or the presence of electrolytes must occur; (2) the emulsified material should be insoluble in petroleum hydrocarbons; (3) the solids content must be readily soluble in some inexpensive chemical; and (4) the particles must have sufficient hardness to withstand high-pressure gradients. The ability of wax and rosin emulsions to meet these requirements and the technique employed for their introduction into the input wells are discussed. Eight references are appended. R. B. S.

1278. Water-Flood Tests on Long Cores. R. A. Morse and S. T. Yuster. *Oil Wkly*, 7.4.47, **125** (6), 36. (*Paper presented at the Tenth Annual Secondary Recovery Conference, School of Mineral Industries, Pennsylvania State College.*)—See Abstract No. 825 (1947). R. B. S.

1279. Water Flooding in Throckmorton County, Texas. P. C. Dean. *Oil Gas J.*, 12.4.47, **45** (49), 78. (*Paper presented before Southwest District Division of Production, A.P.I., Fort Worth*, March 1947.)—Details are given of the geology, development, and production history of the Woodson shallow field in Throckmorton County, Texas. The completion of the input wells, the disposition of the water injection plant, and the various water-flooding patterns in use are also described. Prior to the commencement of water flooding in March 1941 the cumulative production was 39,795 brl; between March 1941 and December 1946 78,807 brl of crude were produced. One section of the field has been flooded with closely spaced input wells whilst another has been flooded with widely spaced inputs. The results obtained in the two cases support the conclusion that wider spacing permits the accumulation of a greater bank of oil ahead of the flood: the growing oil saturation increases the permeability to oil and delays channelling, thereby increasing the efficiency of the flood. R. B. S.

1280. Effect of Increase in Water Pressure on Water Flood Oil Production. H. M. Ryder. *Producers' Monthly*, May 1947, **11** (7), 18. (*Paper presented before Eastern District Division of Production, A.P.I.*, April 1947.)—Some details are given of the sand properties, production, and flooding history of four oil-producing properties in the Bradford area. The results show that the use of high input pressures results in increased ultimate recoveries, other conditions remaining the same. The significance of these results is discussed and the author concludes that great care should be taken in the selection of specifications for input water pressures. R. B. S.

1281. Top Water Control in East Texas. J. O. Crouch. *Oil Wkly*, 28.4.47, **125** (9), 49.—The methods employed in detecting and locating sources of top and intermediate water are briefly reviewed. The use of plastics, which are normally used to control bottom water, for the control of top water, is also discussed. Six references are appended. R. B. S.

Oilfield Development.

1282. Survey of World Oilfields. Anon. *Oil Gas J.*, 28.12.46, **45** (34), 187.—A table gives data on the world's oilfields with the exception of Russia. The data are grouped by countries and include the discovery year, the numbers of flowing and pumping wells, the producing depths, daily average production, cumulative production, number of wells, drilling, name and type of formation, and oil gravity. G. D. H.

1283. U.S.S.R. Needs Equipment. W. W. Burns. *Oil Gas J.*, 28.12.46, **45** (34), 179.—Available information suggests that Russian crude output fell from 620,000 brl/day in 1940 to 406,000 brl/day in 1945. It is believed that there was a slow rise in output in 1946.

During the war about 3000 wells with an output of 37,000,000 brl/day may have been destroyed. According to Perejda the Baku area gave 61% of the 1945 output, Grozny, 6·35%, and Maikop 0·48%. The Sakhalin production was almost doubled during the war, being 6,300,000 brl in 1945. In Sakhalin there are seven fields and six prospects on the east coast, while there are oil and gas seeps on the west coast, one being in the Langary valley and another near N'chaichai.

It is hoped that the U.S.S.R. production will be 261,960,000 brl in 1950 and 435,000,000 brl in 1960. These figures will require much new equipment for their attainment. Great expansion is expected in the Volga area and in the Ural area.

During 1945 Russia imported 4,787,584 brl of products from U.S. alone.

A commercial field has been developed at Tuimazy, and a new field has been found at Buzovny. There are three flowing wells at Tash-Kala.

Gubkin originally estimated Russia's reserves at 18,037,000,000 brl.

Russia's total refining capacity is estimated at 275,000,000 brl/year, and the cracking capacity 85,000,000 brl/year. G. D. H.

1284. Saudi Arabia and Kuwait Expansion Features Middle East Development. Anon. *Oil Gas J.*, 28.12.46, **45** (34), 171.—At the end of 1946 the Middle East output was 779,000 brl/day. During the year there was much expansion of production and refinery output in Saudi Arabia. Rehabilitation in the Far East is slow, and this area which in pre-war days had an output of 225,000 brl/day now gives only 50,000 brl/day. The Middle East now supplies much of the oil formerly provided by the Far East.

Plans are under consideration for laying pipelines to the Mediterranean. It is hoped to raise the Kirkuk output from 90,000 brl/day to 300,000 brl/day by 1949. This output may be provided by twenty wells from a reserve estimated to be 5,000,000,000 brl. Additional pipelines will be laid from Iraq.

The Dukhan field of Qatar is believed to have a large reserve. The Burgan field of Kuwait may have a proved reserve of 5000–10,000 million brl. At present five wells are together providing 40,000 brl/day.

The Sudr wildcat 40 miles south of Suez has found oil.

Bahrein produces 23,000 brl/day, and deeper pays have been tested. No. 10 Abqaiq produces 10,000 brl/day and is believed to raise the reserve to 3,000,000,000 brl. The Qatif discovery well is producing. Abu Hadriya produces from 10,200 ft. Altogether Saudi Arabia produces over 200,000 brl/day and at Ras Tanura 95,000 brl/day is refined. G. D. H.

1285. Anglo-Iranian's July Production is Down. Anon. *Oil Gas J.*, 16.11.46, **45** (28), 161.—Iran produced 12,285,000 brl in May, 11,501,000 brl in June, and 8,778,000 brl in July 1946. G. D. H.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

1286. Gulf Coast Refiners in Greatest Building Programme in History. A. L. Foster. *Oil Gas J.*, 31.5.47, **46** (4), 47.—The Gulf Coast refining industry, active and projected is reviewed.

Of a total cracking capacity of about 1,100,000 brl per day, 400,000 brl is catalytic and 700,000 brl thermal cracking. An additional 100,000 brl capacity of catalytic cracking is planned.

Extensive areas for building are available, close to vast crude-producing areas in Texas and Louisiana, with economical water transportation to the world at large.

The active Gulf Coast refineries are listed, as at January 1, 1947; a second table gives refinery building, new projected and recently completed. Table 3 gives petroleum statistics for January and February 1947 and shows trends in refining outputs and operations, about 30% of total U.S. motor-fuel, and about half the nation's total kerosine output being supplied from the area. G. A. C.

Cracking.

1287. The Kinetics of Catalytic Disproportionation of Hydrogen in Gasoline in the Presence of Activated Clay. G. M. Panchenkov *et al.* *Comptes Rend.* (*Doklady*) *Acad. Sci. URSS*, 1947, **55**, 319 (in English).—The kinetics of hydrogen disproportion were studied with a thermally cracked gasoline with a final b.p. of 150° C and iodine value of 102, using a pelleted clay catalyst which was analysed in detail. The extent of reaction was determined from the iodine value of the products up to a b.p. of 150° C, the results being used to calculate a first-order type rate equation for various combinations of feed space velocity (F.S.V.), temperature and length of catalyst operating cycle between successive regenerations.

The iodine value of the products increased with increasing F.S.V. at fixed temperatures and operating cycles and also with increasing cycle duration, due to the deposition of polymerization products of low hydrogen content "described inappropriately as coke."

At a given F.S.V. the rate is practically independent of temperature over the range 280–400°. It is concluded that the rate of the reaction on the surface of the catalyst is greater than the rate of diffusion of the reactants to the catalyst surface. The first-order rate equation used to express the experimental results is ascribed to the slow diffusion process. G. H. B.

Metering and Control.

1288. Steam Consumption—Part I. Regular Reciprocating Pumps. W. L. Nelson. *Oil Gas J.*, 31.5.47, **46** (4), 273.—No. 146 in the *Refiner's Notebook* series concerns steam consumption of regular reciprocating pumps. A chart is given showing steam required—pounds per hour, capacity of pump—gal per min, and approximate boiler horse-power required. G. A. C.

Refining Patents.

1289. Patents on Refining Processes and Products. Standard Oil Development Co. B.P. 589,546, 9.7.47. Hydrogenation of hydrocarbons.

Shell Development Co. B.P. 589,650, 9.7.47. Synthetic drying oils.

J. C. Arnold (S.O. Dev. Co.). B.P. 589,588, 9.7.47. Gum inhibitors for gasoline.

R. Pool. B.P. 589,691, 9.7.47. Apparatus for the detection of explosive and other dangerous gases.

Auto-Combustions, Ltd., and T. P. Brian. B.P. 589,692–3, 9.7.47. Oil-fuel burners of the atomizer type.

Usines de Melle. B.P. 589,709, 9.7.47. Manufacture of olefins and diolefins by catalytic dehydration.

Smith Bros. & Co. (Oil Distillers), Ltd., and E. J. Kelly. B.P. 589,747, 9.7.47. Liquid lubricants.

J. C. Arnold (S.O. Dev. Co.). B.P. 589,779, 9.7.47. Processes and apparatus employing fluidized solids.

I.C.I. Ltd., and others. B.P. 589,795–6, 9.7.47. Activation of catalysts.

E. C. Hughes, assr to S.O.C. Ohio. U.S.P. 2,411,160, 19.11.46. The reaction product of cashew nut shell oil and phosphorus pentasulphide is used as a lub. oil additive.

D. W. Young and E. Lieber, assrs to S.O. Dev. Co. U.S.P. 2,411,178, 19.11.46. A dicarboxylic-glycol polyester is used as a lub. oil additive.

H. O. Falkins and C. M. Thacker, assrs to The Pure Oil Co. U.S.P. 2,411,200, 19.11.46. Hydrocarbons are cracked in the presence of a brominated ester.

H. J. Hall and J. C. Munday, assrs to S.O. Dev. Co. U.S.P. 2,411,208, 19.11.46. A granular catalyst is employed to remove powdered catalyst from gases after the purification stage of the process.

C. M. Thacker, assr to The Pure Oil Co. U.S.P. 2,411,236, 19.11.46. Mercaptans are obtained from the reaction of paraffin gases and sulphur in the presence of metal sulphide catalysts.

F. E. Frey, assr to Phillips Petroleum Co. U.S.P. 2,411,256, 19.11.46. A process for making butadiene from an ethylene–acetylene mixture.

K. H. Hachmuth, assr to Phillips Petroleum Co. U.S.P. 2,411,264, 19.11.46. Fractionation by distillation of butenes-2 concentrates.

I. H. Kinneberg and C. L. Thomas, assrs to U.O.P. Co. U.S.P. 2,411,275–6, 19.11.46. A rubber-like material is obtained when the reaction product of propylene and a conjugated diolefin with sulphur monochloride is treated with an aqueous solution of a polysulphide.

E. L. Walters, assr to Shell Dev. Co. U.S.P. 2,411,307, 19.11.46. 2 : 4-Dimethyl-6-*tert.*-butylphenol is used to stabilize the amine of an aromatic hydrocarbon.

J. W. Teter and W. J. Merwin, assrs to Sinclair Refining Co. U.S.P. 2,411,346, 19.11.46. Acetonitrile is used as the azeotrope in the separation by distillation of hydrocarbon nitriles and the parent hydrocarbons.

G. R. Lake, assr to Union Oil Co. U.S.P. 2,411,437, 19.11.46. A method of purifying an azeotrope involving dehydration, distillation, and solvent extraction.

A. Wachter and R. S. Treseder, assrs to Shell Dev. Co. U.S.P. 2,411,483, 19.11.46. Antimony halide is used as a corrosion inhibitor in catalytic hydrocarbon conversion.

B. R. Wingrove, assr to Socony-Vacuum Oil Co., Inc. U.S.P. 2,411,492, 19.11.46. A method of removing ash-forming constituents from the wax cake obtained in a solvent dewaxing operation.

L. A. Burrows, assr to du Pont de Nemours & Co. U.S.P. 2,411,502, 26.11.46. Solvent extraction of mineral oils using nitrocyclohexane as the solvent.

T. W. Evans, assr to Shell Dev. Co. U.S.P. 2,411,566, 26.11.46. 1 : 1-Dihalopropene-2 or the 2-alkyl homologues are used to eradicate soil pests.

E. Lieber and M. E. Thorner, assrs to S.O. Dev. Co. U.S.P. 2,411,578–9, 26.11.46. Manufacture of condensation products which act as pour-point depressants.

T. B. McCulloch, assr to S.O. Dev. Co. U.S.P. 2,411,582, 26.11.46. An aviation fuel composition that contains spiropentane.

J. G. McNab and C. Winning, assrs to S.O. Dev. Co. U.S.P. 2,411,583, 26.11.46. A complex organic sulphur compound used to stabilize a lub. oil.

J. R. Morris, assr to The Texas Co. U.S.P. 2,411,586, 26.11.46. Preparation of the barium salts of cyclic-aliphatic ether alcohols.

A. J. Morway and A. Beerbower, assrs to S.O. Dev. Co. U.S.P. 2,411,587, 26.11.46. A mixture of soda and zinc soaps used in making an antifriction bearing lubricant.

J. W. Packie and W. S. Craft, assrs to S.O. Dev. Co. U.S.P. 2,411,588, 26.11.46. Concentration of diolefins by absorption and distillation.

E. D. Reeves, assr to S.O. Dev. Co. U.S.P. 2,411,592, 26.11.46. Design of a fluid catalyst reactor for the dehydrogenation of olefins.

W. G. Routson, assr to Shell Dev. Co. U.S.P. 2,411,593, 26.11.46. A corrosion-preventive composition obtained by dispersing an organic monobasic acid containing a nitroso, nitrile, or nitro group, in mineral oil.

W. J. Sparks and A. H. Gleason, assrs to S.O. Dev. Co. U.S.P. 2,411,599, 26.11.46. A high mol. wt. polymer is obtained by the action of ultra-violet light on methyl acrylate and an alpha olefin.

C. W. Tyson, assr to S.O. Dev. Co. U.S.P. 2,411,603, 26.11.46. A catalytic cracking process on the fluid catalyst principle.

H. G. Smith and T. L. Cantrell, assrs to Gulf Oil Corpn. U.S.P. 2,411,671, 26.11.46. A salt of an alkyl alkylene diphosphate is added to a mineral oil to increase its resistance to foaming.

R. Holroyd and D. H. P. Peel, assrs to I.C.I. Ltd. U.S.P. 2,411,726, 26.11.46. The catalytic dehydrogenation of naphthenes to the corresponding aromatics in the presence of hydrogen.

E. E. Sensel, assr to The Texas Co. U.S.P. 2,411,760, 26.11.46. Conversion of carbon monoxide and hydrogen into compounds of higher mol. wt.

K. H. Hachmuth, assr to Phillips Petroleum Co. U.S.P. 2,411,785, 26.11.46. Furfural and water are used to extract an aliphatic olefin from its mixture with saturated hydrocarbons of the same boiling range.

W. J. Mattox, assr to U.O.P. Co. U.S.P. 2,411,799, 26.11.46. Alumina as catalyst and a hydrogen halide are used to dealkylate a mono-alkyl cyclic compound.

W. H. Rupp and R. O. Wright, assrs to S.O. Dev. Co. U.S.P. 2,411,808–9, 26.11.46. Process and apparatus for separating *iso*butylene from water miscible liquids by distillation and washing.

R. B. Thompson and J. A. Chenicek, assrs to U.O.P. Co. U.S.P. 2,411,817, 26.11.46. The alkylation of *iso*butane with ethylene using $AlCl_3$ catalyst.

E. Amott, assr to Union Oil Co. U.S.P. 2,411,819, 26.11.46. The production of dry metal sulphonates of improved oil solubility.

T. F. Doumani, assr to Union Oil Co. U.S.P. 2,411,822, 26.11.46. The dimerization of a conjugated diolefin in the liquid phase.

T. F. Doumani, assr to Union Oil Co. U.S.P. 2,411,823, 26.11.46. Unsaturated ketones are prepared from an olefin and an acid anhydride using acetyl sulphoacetic acid as catalyst.

H. C. Huffman, assr to Union Oil Co. U.S.P. 2,411,829, 26.11.46. A catalyst consisting of activated alumina, beryllium oxide, and chromium oxide.

H. Linford and W. J. Baral, assrs to Union Oil Co. U.S.P. 2,411,832, 26.11.46. Manufacture of water insoluble soaps.

W. E. Ross and G. J. Carlson, assrs to Shell Dev. Co. U.S.P. 2,411,835, 26.11.46. The isomerization of *n*-pentane to *iso*pentane.

M. De Groote and B. Keeser, assrs to Petrolite Corpn., Ltd. U.S.P. 2,411,957, 3.12.46. Preparation of sub-resinous esteramides.

M. A. Dietrich and C. J. Pedersen, assrs to du Pont de Nemours & Co. U.S.P. 2,411,958–9, 3.12.46. Catalytically active compounds of copper, iron, etc., are removed from petroleum products by washing with aqueous solutions of sodium thioglycolate, thiourea, etc.

T. W. Evans, W. E. Vaughan, and F. F. Rust, assrs to Shell Dev. Co. U.S.P. 2,411,981, 2,411,983, 3.12.46. Process for catalysed abnormal addition reactions.

A. V. Grosse and C. B. Linn, assrs to U.O.P. Co. U.S.P. 2,411,992, 3.12.46. Alkylation of paraffin hydrocarbons using hydrogen fluoride-boron fluoride catalyst.

L. S. Kussel, assr to U.O.P. Co. U.S.P. 2,411,996, 3.12.46. A catalytic cracking process on the fluid catalyst principle.

W. L. Rippeteau, Jr., assr to Phillips Petroleum Co. U.S.P. 2,412,010, 3.12.46. Toluene is purified by distillation in the presence of $AlCl_3$ and metallic iron.

G. B. Zimmerman, assr to U.O.P. Co. U.S.P. 2,412,025, 3.12.46. A catalytic cracking process on the fluid catalyst principle.

W. W. Odell, assr to Lion Oil Co. U.S.P. 2,412,096, 3.12.46. A vapour-phase thermal cracking process employing a reaction chamber containing a porous bed of hot refractory solids.

T. W. Culmer, assr to The Ohio Oil Co. U.S.P. 2,412,131, 3.12.46. A chlorinated sulphurized sperm oil is inoculated with lecithin before use as a cutting oil.

L. P. Evans and F. E. Ray, assrs to Socony-Vacuum Oil Co., Inc. U.S.P. 2,412,135–6, 3.12.46. Method and apparatus for catalytic conversion of hydrocarbons.

M. H. Gorin and W. Swerdloff, assrs to Socony Vacuum Oil Co., Inc. U.S.P. 2,412,143, 3.12.46. Method and apparatus for separation and recovery of soluble catalyst in hydrocarbon conversion reactions.

L. C. Huff, assr to U.O.P. Co. U.S.P. 2,412,152, 3.12.46. A catalytic cracking process on the fluid catalyst principle.

G. A. Ibach and C. C. Tate, assrs to Phillips Petroleum Co. U.S.P. 2,412,220, 10.12.46. Bauxite containing siliceous material is used to extract minor amounts of fluorine compounds in hydrocarbon mixtures.

R. E. Schaad, assr to U.O.P. Co. U.S.P. 2,412,229–30, 10.12.46. A pyrophosphate is used as a catalyst in the alkylation of an aromatic by an olefin.

J. W. Teter, assr to Sinclair Refining Co. U.S.P. 2,412,371, 10.12.46. An oil is subjected to cracking temperature in the presence of aluminium fluoride containing combined water.

E. H. Records. U.S.P. 2,412,427, 10.12.46. Method and apparatus for heat treatment under pressure to refine low-grade hydrocarbon oils.

C. R. Wagner, assr to Phillips Petroleum Co. U.S.P. 2,412,437, 10.12.46. Preparation of unsaturated nitriles.

P. E. McCoy, assr to American Bitumuls Co. U.S.P. 2,412,526, 10.12.46. In coating aggregate with asphalt emulsions an alkali metal dichromate is added to the emulsion to increase its adhesivity.

D. C. Bond and M. Savoy, assrs to The Pure Oil Co. U.S.P. 2,412,550, 10.12.46. A zirconium salt is used as catalyst in the reaction between ethylene and a hydrogen halide.

C. M. Blau, Jr., assr to Petrolite Corpn., Ltd. U.S.P. 2,412,557, 17.12.46. An unsaturated amine-$\alpha\beta$-unsaturated carboxylic acid addition-condensation polymer is used as a lub. oil additive.

E. Lieber, assr to S.O. Dev. Co. U.S.P. 2,412,589, 17.12.46. A condensation product is obtained by the alkylation of an aldehyde resinified aromatic hydrocarbon.

W. N. Axie, assr to Phillips Petroleum Co. U.S.P. 2,412,595, 17.12.46. The alkylation of benzene with ethylene using boron fluoride–orthophosphoric acid as catalyst.

R. E. Burk and E. C. Hughes, assrs to S.O.C. Ohio. U.S.P. 2,412,600, 17.12.46. The hydro-forming of naphtha in the presence of a gel-type catalyst composed of oxides of aluminium, chromium, and molybdenum.

M. L. Schwartz, assr to S.O.C. Indiana. U.S.P. 2,412,633–4, 17.12.46. A corrosion inhibitor for lub. oil which is a mixture of a castor compound and a soap of an oil soluble petroleum sulphonic acid.

J. C. Munday, assr to S.O. Dev. Co. U.S.P. 2,412,645, 17.12.46. Manufacture of aviation gasoline by alkylation of a light fraction of a catalytically cracked naphtha plus catalytic cracking of the heavy fraction.

J. D. Danforth, assr to U.O.P. Co. U.S.P. 2,412,675, 17.12.46. Method and apparatus for isomerization of normal paraffins.

H. M. Grubb and E. B. Tucker, assrs to S.O.C. Indiana. U.S.P. 2,412,679, 17.12.46. Preparation of organic sulphonates and sulphonyl chlorides by treating hydrocarbons with a mixture of SO_2 and chlorine in the presence of a small amount of an organic peroxide.

J. R. Schonberg and D. L. Campbell, assrs to S.O. Dev. Co. U.S.P. 2,412,696, 17.12.46. Method of regeneration of powdered catalysts.

F. E. Frey, assr to Phillips Petroleum Co. U.S.P. 2,412,726, 17.12.46. A process to remove small amounts of dissolved hydrogen fluoride and high boiling organic fluorine compounds from liquid hydrocarbons.

A. R. Workman, assr to Cities Service Oil Co. U.S.P. 2,412,762, 17.12.46. The manufacture of butadiene from propene and formaldehyde using a zirconium chloride catalyst.

L. C. Waterman, assr to Petrolite Corpn., Ltd. U.S.P. 2,412,791, 17.12.46. A process of removing water-dispersible impurities from oil by addition of water followed by electrical separation of the emulsion.

B. J. Mayland, assr to Phillips Petroleum Co. U.S.P. 2,412,823, 17.12.46. Furfural is removed from hydrocarbons of the same boiling point by extraction with water in the presence of a low-boiling liquid hydrocarbon.

J. D. Morgan and A. P. Sullivan, assrs to Cities Service Oil Co. U.S.P. 2,412,827, 17.12.46. A method of detecting free hydrogen in the atmosphere of submarines in the presence of such catalyst poisons as stibene and arsine.

E. A. Naragon, assr to The Texas Co. U.S.P. 2,412,828, 17.12.46. Extraction of aromatics from a naphtha cut by use of an $AlCl_3$ complex and concentration of the aromatics by washing the extract with a paraffinic solvent.

J. R. Rose, assr to Potomac Hydrocarbon Process Corpn. U.S.P. 2,412,837, 17.12.46. A catalytic cracking process in which the catalyst tube is sited in the heater.

J. C. Bolenger and P. W. Prutzman, assrs to Socony-Vacuum Oil Co., Inc. U.S.P. 2,412,863, 17.12.46. A design of contactor for use with acid catalysts.

C. L. Brown, assr to S.O. Dev. Co. U.S.P. 2,412,868, 17.12.46. The activity of the catalyst is maintained in a cracking process using steam by the injection of ammonia at a suitable point.

H. G. M. Fischer, assr to S.O. Dev. Co. U.S.P. 2,412,879, 17.12.46. Thermal cracking of heavy petroleum residues mixed with cellulosic material with continuous removal of frangible, readily crushable coke.

F. E. Frey, assr to Phillips Petroleum Co. U.S.P. 2,412,880, 17.12.46. Azeotropic distillation of butadiene and 2-butene employing SO_2.

R. J. Miller and J. T. Rutherford, assrs to California Research Corpn. U.S.P. 2,412,903, 17.12.46. An oil soluble alkaline earth metal phenate and a zinc thiocarbamate are used as lub. oil additives.

H. W. Scheeline, assr to S.O. Dev. Co. U.S.P. 2,412,911, 17.12.46. Improved manufacture of butadiene from butene-2.

L. W. Schrader, assr to S.O. Dev. Co. U.S.P. 2,412,913, 17.12.46. Design of a high-temperature valve.

J. C. Showalter, assr to S.O. Dev. Co. U.S.P. 2,412,916, 17.12.46. Petroleum sulphonates are obtained by acid treatment of the extract of a naphthenic distillate.

T. P. Simpson, J. W. Payne, and J. A. Crowley, Jr., assrs to Socony-Vacuum Oil Co., Inc. U.S.P. 2,412,917, 17.12.46. A catalytic cracking process on the thermofor principle.

L. G. V. Bogart and R. W. Manuel, assrs to Crane Co. U.S.P. 2,412,929, 17.12.46. A grease-like lub. oil is obtained by mixing castor oil, petroleum oil, bentonite, and triethylphosphate.

H. J. Hepp, assr to Phillips Petroleum Co. U.S.P. 2,412,936, 17.12.46. Manufacture of *cyclo*pentene by catalytic dehydrogenation of *cyclo*pentane. G. R. N.

PRODUCTS.

Chemistry and Physics.

1290. Heats of Adsorption on Carbon Black. I. R. A. Beebe, J. Biscoe, W. R. Smith, and C. B. Wendell. *J. Amer. chem. Soc.*, 1947, **69**, 95–101.—The differential heats of adsorption of nitrogen and oxygen on a series of carbon blacks of varying rubber reinforcing ability were determined at − 195°. The differential heats undergo large variations as successive fractions of the bare surface are covered. Partial graphitization greatly reduces the activity of the more active sites on the surface. This activity as revealed by heat measurements appears to parallel the rubber reinforcing properties of the blacks studied. G. R. N.

1291. Decanes. G. C. Johnson. *J. Amer. chem. Soc.*, 1947, **69**, 147–149.—The decanes formed by hydrogenating the decenes made from *tert.*-amyl alcohol are a mixture of 2 : 2 : 3 : 4-tetramethylhexane, 3 : 3 : 5-trimethylheptane, 2 : 3 : 4 : 4-tetramethylhexane, 2 : 3 : 3 : 4-tetramethylhexane and a small amount of 2 : 3 : 4-trimethyl-3-ethylpentane. The decanes formed by hydrogenating the dimer of 2-methyl-2-butene are 3 : 3 : 5-trimethylheptane, with lesser amounts of 2 : 3 : 4 : 4-tetramethylhexane and 2 : 3 : 3 : 4-tetramethylhexane. The physical properties are given. G. R. N.

1292. An Improved Flow Calorimeter. G. Waddington, S. S. Todd, and H. M. Huffman. *J. Amer. chem. Soc.*, 1947, **69**, 22–30.—An improved constant flow calorimeter for vapours with a precision of $\pm$ 1% is described. The heat capacities of *n*-heptane and 2 : 2 : 3-trimethylbutane were measured at several pressures over the temperature range 330° to 465° K. G. R. N.

1293. Heats of Combustion of Cyclic Hydrocarbons. R. Spitzer and H. M. Huffman. *J. Amer. chem. Soc.*, 1947, **69**, 211–213.—The heats of combustion and formation at 25° C of *cyclo*pentane, *cyclo*hexane, *cyclo*heptane, and *cyclo*octane are given. They are interpreted on the assumption that *cyclo*hexane in the chair form has no strain energy while the other *cyclo*paraffins are strained either by having their C–C–C angles different from tetrahedral or by not having adjacent CH_2 groups rotated 60° with respect to each other. G. R. N.

1294. Heat Capacities, Heats of Fusion and Entropies. S. S. Todd, G. D. Oliver, and H. M. Huffman. *J. Amer. chem. Soc.*, 1947, **69**, 1519–1525.—In continuation of the Bureau of Mines programme on the thermodynamic properties of hydrocarbons the heat capacity data on the six pentenes was determined over the temperature range 12° to 300° K. Values of the triple points and heats of fusion were also recorded. Entropy values for the liquid state at 298·16° K. were also calculated. G. R. N.

1295. Heat Transfer between a Fluid and a Porous Solid Generating Heat. S. R. Brinkley, Jr. *J. appl. phys.*, 1947, **18**, 582.—The theory of heat transfer between a fluid flowing at a constant rate through a porous solid is extended to the case where the solid is a generator of heat. Assuming that the heat source function is a linear function of the temperature of the solid and that its coefficients are independent of position and time, expressions are evolved which give the temperatures of the fluid and solid as functions of position and time. J. T.

1296. High Pressure Hydrogenations with Adams Catalyst. R. H. Baker and R. D. Schuetz. *J. Amer. chem. Soc.*, 1947, **69**, 1250–1252.—Adams and Marshall's method for the reduction of aromatic compounds has been extended to hydrogen pressures as high as 3000 p.s.i. The reductions in acetic acid solution go rapidly at room temperature and it is possible to prepare the perhydro compounds on a preparative scale within a few minutes. The kinetics of the hydrogenation of the monocyclic compounds are consistent with a first order dependence on hydrogen pressure and a zero order dependence on the hydrogen acceptor. The stereochemistry of the reaction was investigated for *m*-xylene, *o*-cresol, naphthalene, and tetralin. The first of these produces a mixture of 77% *trans*- and 23% *cis*-1 : 3-dimethyl*cyclo*hexane. *o*-Cresol and tetralin give *cis*-derivatives, but naphthalene produces a mixture of 23% *trans*- and 77% *cis*-decalin. G. R. N.

1297. Higher Hydrocarbons. IV. F. C. Whitmore, R. W. Schussler, C. S. Rowland, and J. N. Cosby. *J. Amer. chem. Soc.*, 1947, **69**, 235–237.—The methods of preparation, yields, and five important properties of six phenyleicosanes and six *cyclo*hexyleicosanes are reported. G. R. N.

1298. Hydrogenolysis of Aliphatic Alcohols. V. I. Komarewsky, C. F. Price, and J. R. Coley. *J. Amer. chem. Soc.*, 1947, **69**, 238–239.—Primary aliphatic alcohols when subjected to the action of vanadium pentoxide catalyst at 380–400° C and atmospheric pressure were converted to paraffinic hydrocarbons with the same number of carbon atoms. The use of a co-precipitated vanadium pentoxide–aluminium oxide catalyst and superatmospheric pressure gave a substantially improved conversion. G. R. N.

1299. Addition of Hydrogen Bromide to Propylene. F. R. Mayo and M. G. Savoy. *J. Amer. chem. Soc.*, 1947, **69**, 1348–1351.—A preliminary study was made of the kinetics of the addition of hydrogen bromide to propylene in *n*-pentane as solvent. A major obstacle was the difficulty in repressing the abnormal addition of hydrogen bromide even in the presence of inhibitors. The rate of the uncatalyzed normal addition corresponds better to a fourth order reaction, third order with respect to hydrogen bromide, first order with respect to propylene, than to any other integral order. G. R. N.

1300. Addition of Hydrogen Chloride to *iso*Butylene. F. R. Mayo and J. J. Katz. *J. Amer. chem. Soc.*, 1947, **69**, 1339–1348.—The addition of hydrogen chloride to *iso*-butylene in heptane solution at 0° C was studied by a dilatometric method. *tert.*-Butylchloride was the only product found. The addition was greatly accelerated by traces of water, mercury, and phosphorus pentoxide. G. R. N.

1301. Isomeric Alkylbenzenes. A. W. Francis. *J. Amer. chem. Soc.*, 1947, **69**, 1536–1537.—The number of isomeric alkylbenzenes containing from 7 to 25 carbon atoms has been calculated and it is shown that these numbers increase more rapidly than in the case of the paraffin isomers. G. R. N.

1302. Mercaptan Vapours. H. M. Hill and M. L. Wolfrom. *J. Amer. chem. Soc.*, 1947, **69**, 1539.—The laboratory disposal of odoriferous vapours of ethyl mercaptan is accomplished by passage through a column of activated carbon impregnated with cupric chloride. G. R. N.

1303. Nitrogen Compounds in Petroleum Distillates. XXVI. P. L. Pickard and H. L. Lochte. *J. Amer. chem. Soc.*, 1947, **69**, 14–16.—3-Ethyl-5-methylpyridine has been synthesized and shown to be identical to the $C_8H_{11}N$ base isolated from petroleum. Ultra-violet absorption studies show that the natural $C_{11}H_{15}N$ base is an alkylated Bz-tetrahydroquinoline and not 3-*cyclo*pentyl-5-methylpyridine. G. R. N.

1304. Tetraethylbiphenyl. J. V. Karabinos and J. F. R. Kuck, Jr. *J. Amer. chem. Soc.*, 1947, **69**, 1223–1224.—In the synthesis of *s*-triethylbenzene by the ethylation of ethylbenzene with ethyl bromide and $AlCl_3$ it was found that the distillation residue from the preparation contained tetraethylbiphenyl, m.p. 290–291° C. G. R. N.

1305. Tetraethylmethane. A. W. Horton. *J. Amer. chem. Soc.*, 1947, **69**, 182–183.—This nonane was synthesized by the reaction of zinc diethyl with triethylcarbinyl chloride in tetralin solution. The usual physical properties were determined. G. R. N.

1306. Rate of Oxidation of Aromatic Hydrocarbons. L. F. Fieser and S. T. Putnam. *J. Amer. chem. Soc.*, 1947, **69**, 1041–1046.—The oxidation of anthracene by lead tetra-acetate in acetic acid solution is accelerated enormously by water, methanol, or potassium acetate, but is retarded by benzene. A study was made of the rate of oxidation of several polynuclear aromatic hydrocarbons by excess lead tetracetate in 99% acetic acid. Some correlation between rate of oxidation and carcinogenic activity was discernible in specific limited series of compounds. G. R. N.

1307. Structural Determination of Paraffin Boiling Points. H. Weiner. *J. Amer. chem. Soc.*, 1947, **69**, 17–20.—The boiling points of the paraffins may be correlated with structure by means of the equation $\Delta t = (98/n^2)\Delta w + 5{\cdot}5\Delta p$ where Δw and Δp are structural variables which provide simple numerical measures of the effect produced on all atoms simultaneously by a change in position of an atom or of a group. The average deviation between calculated and observed values is less than one degree for the 94 paraffins considered. G. R. N.

1308. Reaction of Propane with Carbon Monoxide. H. Pines and V. N. Ipatieff. *J. Amer. chem. Soc.*, 1947, **69**, 1337–1339.—When propane is condensed with carbon monoxide in the presence of $AlCl_3$ and hydrogen chloride the products obtained are *iso*butyric acid, *iso*butyl*iso*butyrate and 2 : 5-dimethyl-4-hexen-3-one; the respective yields of these compounds, based on carbon monoxide reacted were 5, 44, and 23 mol.-%. G. R. N.

1309. Solid Solution Studies. I. H. L. Fink, M. R. Anes, F. E. Frey, and J. A. Aston. *J. Amer. chem. Soc.*, 1947, **69**, 1501–1506.—Liquid–solid equilibrium phase diagrams have been determined for the systems 2 : 2-dimethylbutane-2 : 3-dimethylbutane and 2 : 2-dimethylbutane-*cyclo*pentane. Each system forms a series of continuous solid solutions containing a maximum in the diagram which has been called a complex. For the latter system the upper and lower transition temperatures have been determined over the range of composition where the transitions occurred as well as the heats of transition and fusion. The lower transition is found only for the pure components and mixtures having compositions between 70 and 100 mol-% *cyclo*pentane, while the heat of this transition per mol of mixture decreases from 1165 cal. at 100 mol-% *cyclo*pentane to 0 cal at approx. 68 mol-%. The upper transition is found only for the pure components and mixtures between 60 and 100 mol-% *cyclo*pentane. G. R. N.

1310. Sorption of Hydrogen on Alumina. A. S. Russell and J. J. Stokes, Jr., *J. Amer. chem. Soc.*, 1947, **69**, 1316–1319.—The sorption of hydrogen on various samples of alumina has been measured from 400° to 900° and from 9 to 620 mm. Sorption is in the range 0·05 to 0·2 ml S.T.P./g increases with decreasing temperature and increases proportional to the fourth root of pressure. Sorption equilibrium is slow and difficult to reproduce and there is evidence of an irreversible hydrogen reaction on alumina. The samples tested have sorption in the same range in spite of large differences in their surface areas and impurity contents. G. R. N.

1311. Vapour Pressures and Vapour Densities. W. B. Kay. *J. Amer. chem. Soc.*, 1947, **69**, 1273–1277.—The standard boiling points and the critical constants for *cyclo*pentane, methyl*cyclo*pentane, ethyl*cyclo*pentane, and methyl*cyclo*hexane were determined. The vapour pressures and saturated liquid and vapour densities of these compounds were determined from near their standard boiling points to their critical points. The data have been represented by empirical equations: (*a*) the vapour pressure data by equations of the type $\log p = A + B/T$ supplemented by deviation curves; (*b*) the density data by means of the equation of Fules and Shapiro together with the equation for the sum of the liquid and vapour densities. Values of the constants in the equations are given. G. R. N.

1312. Electron Diffraction Study of Oleophobic Films on Copper, Iron, and Aluminium. L. O. Brockway and J. Karle. *J. Coll. Sci.*, 1947, **2** (2), 277–287.—The formation of oleophobic films adsorbed from solutions on to metals (see Abstract No. 899, 1947) has been studied with the aid of electron diffraction. It was found that the metal surfaces must be very carefully prepared by polishing and cleaning, since the molecules of adsorbate normally stand perpendicular to the oil-film interface. That in many cases the molecules of the adsorbate have a tilt, as determined by electron diffraction, of 5° on the average is due to the submicroscopic unevenness of the surface, and, in fact, the degree of tilting is a measure of the unevenness of the surface.

Solutions of *n*-octadecylamine and of stearic acid in cetane, ranging in concentration from 0·1 to 0·001% are used. The films require less time to form from the more

concentrated solutions, and show no tendency to do so from the 0·001% solutions. The rate of film formation is also increased at lower temperatures.

The smooth surfaces of copper, iron, and aluminium consist of the oxides, and the similarity of all films, both as regards time of formation and structure, with each other and with those formed on platinum, indicates that chemical forces do not affect adsorption. H. C. E.

1313. Gels and Jellies of Aluminium Dilaurate in *cyclo*Hexane and Benzene Examined by X-Ray Diffraction. S. S. Marsden, K. J. Mysels, and G. H. Smith. *J. Coll. Sci.*, 1947, **2** (2), 265–269.—The systems formed by aluminium dilaurate (I) in solvents can be divided into gels or jellies according as crystallites of I appear or not. The systems are prepared in evacuated thin-walled soft-glass capillaries since they are sensitive to atmospheric moisture and are required in concentrated form. 30% of I in *cyclo*hexane, examined after cooling from 38, 80, and 150° C, shows that gel formation does not affect the structure of the bulk of the crystallites. 40% of I in benzene, after cooling from 150° C, gives a diffraction pattern which indicates the disappearance of the crystallites and the probable formation of micelles of oriented soap layers. H. C. E.

1314. Pressure and Oil Flow in Oil-filled Cables at Load Variations. H. L. Knudsen. *J. appl. Phys.*, 1947, **18**, 545.—A method is given for calculating pressure and oil flow in a section of an oil-filled cable at load variations. The hydraulic resistance of the oil canals and the elasticity of the sheath and the pressure armour and the compressibility of the oil have been taken into account.

Only those cable sections terminated with oil reservoirs in which the pressure is constant are dealt with. Curves and formulæ are given for the calculation of pressure and oil flow and the method is illustrated by numerical examples. J. T.

Analysis and Testing.

1315. Oxygen Boost Method of Rating the Engine Performance of Aviation Fuels. W. B. Heaton, T. K. Hanson; and R. C. Morris. *J. Inst. Petrol.*, 1947, **33**, 256.—By supercharging and employing fuel injection and by incorporating various modifications to a standard Motor Method (F.2) C.F.R. engine a method is developed where, as an alternative to supercharging with compressed air, oxygen is directly used from a cylinder. The modifications and operational conditions are given. The performance numbers are obtained from a knowledge of the rich-mixture response curves of two reference fuels, where the response curves are obtained by plotting oxygen flow against the fuel flow. The engines thus evolved correlated well with Pegasus and Hercules single-cylinder engines. J. T.

1316. Melting Point Calorimeter. J. G. Aston, H. L. Fink, J. W. Tooke, and M. R. Anes. *Anal. Chem.*, 1947, **19**, 218–221.—A melting point calorimeter to determine the purity of organic compounds which are liquid at or below room temperature is described. Its design follows that developed in precision low temperature adiabatic calorimetry. Modifications have reduced the time of a melting point determination to 8 hours. Results indicate a precision for heat capacities of about 3%, for heats of fusion about 5%, and for triple points about 0·03° C. G. R. N.

1317. Rapid Determination of Small Amounts of Carbon Monoxide. M. Shepherd. *Anal. Chem.*, 1947, **19**, 77–81.—A condensed report that gives the minimum preliminary information necessary to make and use the National Bureau of Standards indicating gel for the rapid colorimetric determination of small or physiologically significant amounts of carbon monoxide in air in the field or laboratory. The gel will detect and estimate less than 1 part of carbon monoxide in 500 million parts of air. It will detect 0·001% by volume in less than 1 min. and determine physiologically significant amounts in approx. 1 min. Field use requires a small inexpensive apparatus without maintenance problems and involves procedures so simple that untrained personnel will obtain reliable results. G. R. N.

1318. Analysis of Silica-Alumina Cracking Catalysts. R. A. Burdett and L. C. Jones, Jr. *Anal. Chem.*, 1947, **19**, 238–241.—A spectrographic method for the determination

of iron, sodium, vanadium, nickel, chromium, and copper in silica–alumina cracking catalysts incorporating a novel photometric technique is described. The procedure is rapid and correlates well with the conventional chemical analysis. G. R. N.

1319. Microdetermination of Lead Tetraethyl in Gasoline. B. E. Gordon and R. A. Burdett. *Anal. Chem.*, 1947, **19**, 137–140.—The method is based on the decomposition of the lead tetraethyl with iodine, evaporation of the volatile constituents, destruction of the organic residue with mixed sulphuric, nitric, and perchloric acids, and subsequent volumetric microdetermination of precipitated lead chromate. The accuracy and reproducibility of the method conform to A.S.T.M. specifications. G. R. N.

1320. Determination of Aromatics and Naphthenes in Gasoline. R. M. Love, A. R. Padgett, W. D. Seyfried, and H. M. Singleton. *Anal. Chem.*, 1947, **19**, 37–42.—A rapid method was developed to determine the aromatics and naphthenes in gasolines boiling in the range 93° to 149° C and which may contain up to 40% olefins. The first step is to remove olefins and diolefins and this is accomplished by controlled bromination followed by steam distillation. The sample is then distilled into fractions and the aromatics in each fraction are removed by treatment with 93–94% sulphuric acid. The refractive index of the sample before and after acid treatment is used to calculate the aromatic content. With the aid of a chart the naphthene content is calculated from the refractive index and the average boiling point of each fraction. The method is accurate to about $\pm$ 0·3% on aromatics and about $\pm$ 1·0% on naphthenes. G. R. N.

1321. Determination of Paraffins and Naphthenes in Gasolines. S. C. Hinden and A. V. Grosse. *Anal. Chem.*, 1947, **19**, 42–47.—A weighed amount of gasoline (1 to 5 g) is burned in an A.S.T.M. sulphur lamp in a stream of dry air. The water formed is collected on a dessicant, $CaCl_2 + P_2O_5$ and weighed. From this the hydrogen/carbon ratio is calculated. With the aid of a graph relating boiling point and hydrogen/carbon ratio for paraffin hydrocarbons and the formulæ $\frac{x-2}{a-2} \times 100 =$ wt.-% paraffins and $\frac{a-x}{a-2} \times 100 =$ wt.-% naphthenes, where $x =$ the experimentally determined H/C ratio of the sample, *i.e.*, a paraffin–naphthene mixture, and $a =$ the H/C ratio of the paraffins boiling in the same range, the paraffin and naphthene content of the gasoline can be calculated. The accuracy of the method is independent of the isomeric composition of the sample; it varies from $\pm$ 1·5% paraffin in the C_8 cut up to $\pm$ 3·0% in the C_{12} cut. G. R. N.

1322. Constant Delivery of Liquid at Constant Rate. A. R. Richards. *Anal. Chem.*, 1947, **19**, 281.—When a large quantity of liquid is to be delivered continuously it is common practice to provide two containers refilling one while liquid is being delivered from the other. The operation of the system is invariably disturbed while the delivery rate from the refilled container is being adjusted. A simple apparatus is described which overcomes this by maintaining a constant liquid head across the control valve. It also allows a reduction in the size of container. G. R. N.

1323. Vacuum Micromanometer. W. S. Young and R. C. Taylor. *Anal. Chem.*, 1947, **19**, 133–135.—A vacuum gauge particularly suited to the pressure range of 10^{-1} to 10^{-3} mm mercury is described. It is based on the movement of a bubble of gas trapped in a capillary tube connecting two large reservoirs of liquid. Movement is caused by pressure acting upon the liquid in one reservoir while the other is maintained at a constant reference vacuum. Readings are independent of both the physical properties of the gas and the presence of condensables in a gas mixture. At present the gauge is finding application in mass spectrometry and in the rapid mol. wt. determinations of volatile liquids. G. R. N.

1324. Molecular Weight Determination of Volatile Liquids. W. S. Young and R. C. Taylor. *Anal. Chem.*, 1947, **19**, 135–137.—The method is a modification of the Gay-Lussac vapour density procedure in which a small accurately measured quantity of liquid is transferred to an evacuated vessel at room temperature and the pressure is

measured with a vacuum micromanometer (cf. preceding abstract). Results in a number of organic compounds in the vapour pressure range from 750 to 0·3 mm mercury at room temperature indicate that an average accuracy of approx ± 2% may be realized in an elapsed time of 3 to 4 min. per determination. The method was developed primarily to obtain the mol. wt. of gasoline and its fractions, but it has a wider application. G. R. N.

1325. Determination of Mono- and Dialkylacetylenes. C. D. Wagner, T. Goldstein, and E. D. Peters. *Anal. Chem.*, 1947, **19**, 103–105.—A method is described for determining mono- and dialkylacetylenes of 4 and 5 carbon atoms, in the presence of related paraffins, olefins, or diolefins. The method is based on the reaction of the alkynes with methanol in the presence of a catalyst mercuric oxide–boron trifluoride to produce ketals which are subsequently hydrolyzed to ketones. Allenes and high concentrations of peroxides and *cyclo*pentadiene interfere. Interference by carbonyl compounds originally present is obviated by suitable blank tests omitting the catalyst. Although the method does not generally give stoicheiometric results recoveries of about 92% are consistently obtained making possible the use of 1·09 as an empirical correction factor. The time of analysis is 2 to 3 hours. G. R. N.

1326. Analysis of Naphthalene–Tetralin–Decalin Mixtures. W. J. Cerveny, J. A. Hinckley, Jr., and B. B. Corson. *Anal. Chem.*, 1947, **19**, 82–86.—A rapid method for analysing any mixture of naphthalene, tetralin, and decalin with an accuracy of ± 1% for each component consists of taking two measurements—the heat of the reaction of the mixture with nitrating acid and the temperature at which naphthalene begins to crystallize on cooling the mixture. An alternative method consists of separating the mixture by distillation into an overhead and residue fractions then measuring the specific dispersions of the fractions. G. R. N.

1327. Micro-Determination of Gaseous Olefins. R. Pyke, A. Kahn, and D. J. LeRoy. *Anal. Chem.*, 1947, **19**, 65–66.—The reaction between olefins and mercuric acetate is employed to separate gaseous olefins from the corresponding paraffins in micro samples. The method employs the Blacet–Leighton gas analyser, the absorbent being a paste of mercuric acetate boron trifluoride ethyl etherate and ethylene glycol. Another absorbent used was a paste of water, mercuric nitrate, and mercuric acetate. G. R. N.

1328. Infra-red Spectrometric Quantitative Analysis. J. W. Kent and J. Y. Beach. *Anal. Chem.*, 1947, **19**, 290–293.—A method is described for making rapid accurate analysis of liquid hydrocarbon mixtures for all components. The method is a combination of distillation, infra-red spectrometric and calculation procedures. It has been applied to a wide variety of mixtures containing paraffin and *iso*paraffin hydrocarbons boiling between 28° and 124° C. Tests of Beer's law and optical density additivity are presented for several synthetic mixtures. The accuracy of the method is shown to be approx. 1% for each component. G. R. N.

1329. Infra-red Spectrometric Analysis. J. J. Heigl, M. F. Bell, and J. U. White. *Anal. Chem.*, 1947, **19**, 293–298.—The application of infra-red spectroscopy to the analysis of hydrocarbon mixtures is described in detail. Emphasis is placed upon accuracy, rapidity, and simplicity of the "base line" technique which uses spectra superimposed on the radiant energy background. An analysis of an octane fraction illustrates development of the procedure. Instrumental requirements for satisfactory accuracy are listed. G. R. N.

1330. Short-Cut Methods of Infra-red Analysis. W. D. Seyfried and S. H. Hastings. *Anal. Chem.*, 1947, **19**, 298–304.—In connexion with commercial-scale and pilot-unit operations for the production of butadiene from butylenes, a number of short-cut infra-red procedures have been developed for the rapid, accurate determination of certain key components in samples containing other compounds whose measurement is not necessary or which can be determined readily by other means. Although some of the procedures are applicable only for specific purposes, others are general in nature and may be applied to a wide variety of purposes. The procedures may be divided into

three categories: base-line methods (*iso*butylene and *iso*butane in admixture with other C_4 hydrocarbons); procedures based upon measurements of optical density at unique wave lengths (methane, CO, and CO_2 in admixtures with hydrogen and small amounts of C_2 and lighter hydrocarbons); and comparison standard techniques (butadiene-1 : 3 product purity and butadiene-1 : 2 in admixture with other C_4-hydrocarbons). G. R. N.

1331. Mass Spectrometry. S. E. J. Johnsen. *Anal. Chem.*, 1947, **19**, 305–306.—A new method of mass spectrometric analysis is proposed in which the usual pressure measurement of the sample prior to expansion is not necessary. Peak ratios are used throughout and the method is claimed to be capable of general application except in the analysis of ternary isomeric mixtures. G. R. N.

1332. Constant Ratio Still Head. L. E. Lloyd and H. G. Hornbacher. *Anal. Chem.*, 1947, **19**, 120–123.—The still heads described are based on the principle of two condensing surfaces in parallel—one to give reflux, the other to give the product. A general discussion (with 44 references) of laboratory still heads is set out. G. R. N.

1333. Determination of Sulphur in Organic Compounds. E. C. Wagner and S. H. Miles. *Anal. Chem.*, 1947, **19**, 274–277.—A procedure for the volumetric semimicro-determination of sulphur depends on the combustion of the sample in the Parr oxygen bomb and determination of the resulting sulphuric acid by precipitation as benzidine sulphate and titration with standard alkali. G. R. N.

1334. Sudden Application of a Constant Shearing Motion to Anomalous Fluids. E. K. Carver and J. R. Van Wazer. *J. Phys. Colloid. Chem.*, 1947, **51**, 751.—A viscometer of rotating cup type which could be made to rotate suddenly at constant speed is fully described. Photographic recordings are made of the stress *v.* time when a given constant rate of shear is suddenly applied to the fluid contained between the concentric cylinders. Newtonian as well as a number of non-Newtonian fluids and, in particular, an aluminium soap dissolved in gasoline are studied. The graph of force *v.* time for this material shows a maximum near the time rotation is started. It is shown from these photographic traces that the gel has a cross-bonded structure which is partially destroyed under shear. The structure is reformed upon standing undisturbed for several hours, the activation energy responsible for this process being 9 kg.-cal. The activation energy for flow is zero. This is because the mechanism of flow is a combination of breaking bonds and the normal type of internal friction.

1335. Capillary Type Viscometer. D. P. Shoemaker, E. Hoerger, R. M. Noyes, and R. H. Blaker. *Anal. Chem.*, 1947, **19**, 131–132.—The viscometer was employed to the study of concentrated solutions of large molecules in volatile solvents and found to give more reproducible results than the Ostwald type. It is relatively free from errors due to concentration changes. G. R. N.

Lubricants.

1336. Graphited Lubricant for Modern Running-in. Anon. *Oil Engine and Gas Turbine*, June 1947, **15** (170), 59.—The addition of colloidal graphite to the lubricating oil during the bedding-in of opposed working faces will eliminate metal pick-up and reduce wear.

If nickel-chrome liners and chromium-plated rubbing surfaces are treated with colloidal graphite, a far better degree of oil spread is obtained, since the graphoid surface improves the oil-holding quality of the bearing surface. In addition, the microscopic particles of graphite interpose themselves between the high spots of opposed rubbing surfaces, and thus provide adequate lubrication if the oil film is ruptured.

A better protection is given to the working faces of a new engine if a mineral oil containing a relatively high percentage of colloidal graphite is applied to all rubbing surfaces during assembly. A running-in compound containing colloidal graphite should also be added to the crankcase oil. C. D. B.

Special Hydrocarbon Products.

1337. Most Outstanding U.S. Organic Chemical Development Now in High Gear. A. L. Foster. *Oil Gas J.*, 31.5.47, **46** (4), 205.—A review of the petroleum chemical manufacturing industry in the Gulf of Mexico is given.

An extensive range of organic chemicals are or will be produced in this area, which is ideally situated for water transport and has an abundance of petroleum products as raw materials and a third of U.S. refining capacity.

New and recent building activities and expansion in petroleum chemical manufacture are shown in a table; a second table shows rubber and rubber intermediate plants in the area.

Among the outstanding chemical plants on the Gulf Coast is the Deer Park refinery of the Shell Chemical Co. Large quantities of glycerin are synthesized in the plant by the hydration of propane or propylene to form propylene to which is added three hydroxyl groups with the aid of chlorine and caustic soda.

This company is also constructing a unit for synthesis of 18,000,000 gal ethyl alcohol annually.

The Carthage Hydrocol Company are building a plant to make 6000 brl/day of motor and other fuels from natural gas by an improved Fischer–Tropsch synthesis.

G. A. C.

Derived Chemical Products.

1338. The Petroleum-Chemicals Industry. R. F. Goldstein. *Petrol. Times*, 7.6.47, **51**, 524.—This is the first of a series of articles reviewing the trends and developments in the petroleum-chemicals field: a petroleum-chemical is taken as meaning a synthetic organic chemical manufactured from a petroleum starting material.

The main sources of petroleum-chemicals are the saturated or unsaturated hydrocarbons which under ordinary conditions are gases: thus one of the basic processes in the petroleum-chemicals industry is the separation of gases into their individual constituents. The standard methods of separation include fractional distillation, adsorption on active carbon, absorption by chemical reagents, and "Hypersorption"—a new process which is briefly discussed. The author also discusses the various methods of production of synthetic glycerol and newly discovered reactions of olefines, glycols, and olefine oxides.

R. B. S.

Miscellaneous Products.

1339. Secrets of German Fuel Technology Unearthed. Anon. *Petrol. Times*, 7.6.47, **51**, 550.—The following BIOS and FIAT reports are briefly reviewed:

BIOS Final Report No. 877. Oxidation of Hydrocarbons to Ethylene and of Methane to Acetylene, with Conversion of Acetylene to Acetone.

FIAT Final Report No. 299. Supplemental Report on the Ruhrol Hydrogenation Plant, Welheim, Ruhr.

R. B. S.

Engines and Automotive Equipment.

1340. 3500 H.P. Pratt and Whitney Wasp Major. Anon. *Flight*, July 1947, **52**, 12*a*.—Constructional and design features of this new high-power American engine are divulged. Major data include:—

Bore	5·75 in (146 mm)
Stroke	6·00 in (152·4 mm)
Total displacement	4363 cu. in. (71·5 litres)
Compression ratio	6·7 : 1
Maximum B.M.E.P.	200 p.s.i.
Airscrew reduction gear ratio	0·381 (or 0·425)
Airscrew shaft rotation (from rear)	Clockwise
Diameter: TSB3-G; VSB11-G	53·5 in; 52·5 in
Length	96·75 in
Dry weight (including torquemeter and accessories) TSB3-G; VSB11-G	3,490 lb; 3,410 lb
Maximum oil consumption at rated power	0·025 lb/b.h.p./hr

I. G. B.

1341. Modern Trends in Bearing Metals. P. T. Holligan. *Oil Engine and Gas Turbine*, May 1947, **15** (169), 28; June 1947, **15** (170), 44.—The real area of contact between two mating surfaces is extremely small, and is dependent mainly on the load; intense local pressures and high temperatures may be developed. Among other desirable properties, therefore, a bearing metal must have high load-carrying capacity, high fatigue strength, and a high thermal conductivity.

It is not yet certain whether the presence of hard crystallites in a soft matrix has any advantage for a bearing metal, but under practical running conditions, the hard constituents may play a small but significant rôle in imparting superior mechanical and physical properties to the oil.

Tin and lead-base white metals possess most of the properties necessary for a good bearing, but they have limitations owing to their low compressive and fatigue strength. These defects can be partly remedied by reducing the thickness of the lining to a minimum of about 0·010 in. If the lining is thinner than this, the bearing shell must be manufactured to closer tolerances, and severe scoring of the white metal may occur if particular attention is not paid to filtration.

Cadmium-base alloys, which have better mechanical properties than the white metals, have limitations in that (*a*) they are expensive to manufacture, owing to their loss by oxidation when in the molten state, and (*b*) they are susceptible to corrosion by oil acids.

Aluminium-base bearing metals have disadvantages in that, being relatively hard, they must be used with hardened shafts, and they also tend to lose interference fit in the engine owing to their low elastic limit.

It has been found that a thin film of lead (to a thickness of 0·004 in) on a copper base reduced friction to a minimum; with a harder metal base a thinner film was required. This is the basis of the lead-bronze bearing, which, however, is not suitable for main and big-end bearings as it is too hard. Softer shaft materials can be used if the lead content of the alloy is increased, but this results in decreased mechanical strength.

For this reason, copper–lead " alloys " must be bonded to steel shells, the resultant bearings having high load-carrying capacity and high fatigue strength at elevated temperatures. Under conditions of temporary oil shortage or excessive loading, a film of lead is extruded from the lining, and is " wiped " over the bearing surface, thus reducing friction. Coating the bearing surface with a thin film of pure lead will facilitate the running-in process.

For a high load-carrying-capacity bearing suitable for use with soft shafts, alloys are being developed with a higher lead content than the 70/30 copper–lead bearings at present in use. With these higher lead contents, lead plating of the copper–lead surface is no longer essential. C. D. B.

MISCELLANEOUS.

1342. United Kingdom Petroleum Trade in 1947. (Details for May). Anon. *Petrol. Times*, 5.7.47, **51**, 663.—Tables are presented of U.K. imports and exports of crude oil and refined products for May and the first five months of 1947. Comparative figures for the corresponding periods of 1946 are also given. R. B. S.

1343. Fuel Oil Developments in the U.K. N. L. Hudson. *Petrol. Times*, 24.5.47, **51**, 475.—Fuel oil developments in the U.K. are briefly reviewed. R. B. S.

1344. Synthetic Oil in Japan. Anon. *Industr. Chem.*, 1947, **23**, 333–340.—The Japanese commenced research on oil from coal in 1921, but the Government did not give any assistance until 1936, when the production of oil from Japanese and Manchurian coals was stimulated. Both Fischer–Tropsch and low temperature carbonization processes have been investigated, but the latter are preferred. Descriptions of various installations are given. During the peak year (1944), only 100,000 tons of synthetic oil were produced in the Japanese Empire. In the last year for which reliable data are available (1936) Japan produced 330,000 tons of natural crude oil and the rest of the Empire 175,000 tons. In the same year the low temperature plant at Fushun in Manchuria produced 125,000 tons. Total output from the other four similar plants was under 4000 tons. Imports in the same year were 2·14 million tons of crude oil and 2·5 million tons of petroleum products. F. S. A.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	350 A
Geophysics and Geochemical Prospecting	355 A
Drilling	356 A
Production	359 A
Oilfield Development	365 A
TRANSPORT AND STORAGE ...	370 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	371 A
Solvent Extraction and Dewaxing	371 A
Cracking	372 A
Polymerization	372 A
Special Processes	372 A

	PAGE
PRODUCTS.	
Chemistry and Physics ...	373 A
Analysis and Testing	373 A
Gas	375 A
Engine Fuels	375 A
Gas and Fuel Oil	376 A
Lubricants	377 A
Derived Chemical Products ...	378 A
Coal, Shale and Peat	378 A
Miscellaneous Products ...	379 A
ENGINES AND AUTOMOTIVE EQUIPMENT	379 A
MISCELLANEOUS	382 A
BOOKS RECEIVED	383 A

AUTHOR INDEX.

The numbers refer to Abstract Numbers.

Abadie, H. G., 1396
Anderson, F. M., 1399

Baker, J. S., 1433
Ballande, H. M., 1531
Bastiansen, O., 1493
Berret, R., 1486
Berti, V., 1506
Bieloch, W., 1507
Boice, J. E., 1501
Boyer, R. I., 1414
Brise, V. H., 1502
Brown, L. C., 1482, 1479
Burns, W. W., 1376, 1383, 1439, 1449, 1465, 1470

Calhoun, Jr., J. C., 1425
Canal, P., 1495
Cannon, G. E., 1397
Cardwell, P. H., 1418
Carter, H. D., 1514
Cauley, S. P., 1499
Clay, J. A., Jr., 1475
Coburn, A. E., 1496
Cotey, B. J., 1408
Coultrup, J. G., 1428
Cozzens, F. R., 1437
Crowell, A. M., 1447

David, H., 1348
Deegan, C. J., 1349, 1355, 1382, 1443
Deely, C., 1391
Delgass E. B., 1499

Edmister, W. C., 1411

Fagin, K. M., 1409
Featherly, R. L., 1472
Fiske, F. K., 1380
Forman, H., 1471
Foster, G. L., 1505
Fulton, D., 1478

Gerard, P., 1503
Gile, R. E., 1394
Glasgow, A. R., Jr., 1488
Gonikberg, M. G., 1487
Gorshkov, G. V., 1395
Goulding, H. D., 1513

Hassel, O., 1493
Heald, K. C., 1347
Hemsley, H. L., 1410
Hoeven, H. Van Der, 1476
Hoge, A. W., 1481
Holligan, P. T., 1504
Howes, D. A., 1526
Hughes, R. V., 1429

Jakovsky, J. J., 1346
James, J. R., 1472
Johnson, K. H., 1406
Jones, P. J., 1431, 1432

Katz, D. L., 1438
Kazarnovskaya, B. B., 1401
Kelso, G., 1481
Kettering, C. F., 1498
Kimbrell, W. B., 1398
Kling, R., 1518
Krampert, E. W., 1359

Lahee, F. H., 1352
Langseth, A., 1493
Lawton, H. C., 1426
Legrand, C., 1494
Liatkovskaya, N. M., 1395
Lilley, H. S., 1505
Lindblad, E. N., 1420
Logue, L. L., 1380
Lozier, P. De, 1433
Lundberg, H., 1381

McCollum, L. F., 1450
McGarry, R. J., 1411
McKetta, J. J., 1438
Mark, B., 1447
Marshall, D. L., 1416
Miller, E. F., 1500
Morgan, F., 1414
Moult, E. S., 1509
Moyer, V., 1421
Muskat, M., 1414
Myers, G. D., 1481

Nelson, F. L., 1500
Nelson, W. L., 1477
Neubauer, R. T., 1474
Nevolin, N. V., 1374
Noble, E. B., 1345
Norelius, R. G., 1423

Olds, R. H., 1419
O'Leary, C. M., 1392
Oliphant, S. C., 1413
Owsley, D., 1407

Paleni, A., 1508
Panchenkov, G. M., 1480
Parsons, R. L., 1420
Peavy, C. C., 1481
Pfister, R. J., 1429
Phinney, J. A., 1484
Pokrovskaya, E. S., 1485
Polk, A. C., 1417

Radford, H. E., 1400
Rassemuss, J. E., 1458
Riggs, C. H., 1406
Roberts, G., 1484
Rogers, M. C., 1491
Rossini, F. D., 1488

Sage, B. H., 1419
Saito, E., 1489
Salvi, G., 1506
Schaefer, H., 1415
Schweitzer, P. H., 1517
Scott, D., Jr., 1434
Serruys, M., 1497, 1523
Shaw, M. C., 1474
Shepherd, M., 1492
Short, E. H., Jr., 1385, 1393
Sinoley, E. R., 1479
Skogan, V. G., 1491
Smith, R. H., 1417
Smith, S., 1413
Squires, F., 1430
Standing, M. B., 1430
Stepantseva, T. G., 1485
Sterne, W. P., 1384
Sterrett, E., 1386, 1403
Stick, J. C., 1433
Streiff, A. J., 1488
Swesnik, R. M., 1388

Taylor, H., 1354
Tears, C. F., 1479
Terwilliger, P. L., 1435
Thornton, O. F., 1416
Topchieva, K. V., 1480
Toussaint, J. E., 1402
Trillat, J. J., 1494
Trishman, L. E., 1389

Vereshchagin, L. F., 1487

Wais, J., Jr., 1388
Watts, E. V., 1422
Weeks, L. G., 1365, 1366
Wilcox, O. W., 1448
Williams, N., 1427
Willingham, C. B., 1488
Wilson, G. M., 1387, 1390
Winterburn, E., 1406

Yuster, S. T., 1425, 1435

Oilfield Exploration and Exploitation.

Geology.

1345. Geological Masks and Prejudices. E. B. Noble. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1109–1117. (*Presidential address, 32nd Annual Meeting of Amer. Assoc. Petrol. Geol., Los Angeles*, March 25, 1947.)—The American petroleum industry has grown tremendously in the last 10 years. During this period, exploration has resulted in discoveries that have increased the net reserves of crude oil by 38%. Nevertheless, during the last half of this period there has been a gradual decline in the rate of finding new high-quality fields.

In order to maintain the United States' reserves, nearly 2000 million brl of new oil must be found each year. Until research can provide a new method of discovery, exploration will consist of reworking previously explored areas in greater detail. Many new oilfields undoubtedly lie hidden under geological masks—that is to say, in sediments hidden by overthrust older rocks, volcanics, thick deposits of drift, multiple unconformities, and shallow seas.

Drilling costs have always been a major problem in exploration, and the present high cost of water operations and of prospecting in remote or difficult areas on land suggests that we are entering an era of million dollar wildcats. The designing of cheaper drilling equipment for deep geological investigations should be one of the major objectives in applied research. Increasing opportunities will exist for applying geological principles in oil exploration, and more geologists will be needed for this purpose. More senior geologists should be relieved of routine duties and allowed to concentrate on the problem of finding new oil provinces. E. N. T.

1346. Whither Exploration? J. J. Jakovsky. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1118–1124. (*Presidential address, Society of Exploration Geophysicists, Los Angeles*, March 25, 1947.)—The author presents data showing the relative increases during the past decade of lease operating costs, drilling or development costs, and exploration costs.

In the past 10 years in the United States petroleum industry, which is the second largest industry in the United States, the lease operating costs have increased by only 17%. There has been an increase of about 70% in basic wages and other costs during this time, but better operating efficiency has held the lease operating costs below the value which might be expected in view of the general price rises during this period. The development costs have increased by 80% during the past decade, and the percentage of dry holes has risen from 13·5 to 27%. During the past 10 years, however, exploration costs have increased by more than 400%. The reason for these greatly increased exploration costs is chiefly due to the decrease in effectiveness in both geological and geophysical techniques as old areas are reworked.

Exploration activities have been stimulated by the price increases of crude oil during the past few months. New technological developments are needed and can be stimulated by clarifying the patent situation, thereby allowing earlier publication of new fundamental and applied research. On the basis of geologic probability much oil still exists to be discovered in the subsurface. E. N. T.

1347. Highlights of Domestic (U.S.A.) Development in 1946. K. C. Heald. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1125–1134.—The author reviews developments in the United States oil industry during 1946. On January 1, 1947, the United States proved oil reserves amounted to more than 21 million brl, a figure higher than a year previously. Nevertheless, in some districts proved reserves declined.

More wildcat wells were drilled in 1946 than in any preceding year, but fewer fields were found than in 1945 or 1944. The previously known reserves were increased by the discovery of extensions to older fields and of new pay horizons in those fields.

In Louisiana the world's deepest oil-producing well was completed, giving 530 brl/day at 13,753 ft. Unlike many deep wells, it gives oil of moderately low gravity (33° A.P.I.).

A review of geological and drilling progress in the different states of the U.S.A. is given. E. N. T.

1348. Discoveries : Industry Ends Greatest Wildcatting Year. H. David. *Oil Gas J.*, 25.1.47, **45** (38), 148.—The 4518 exploratory wells drilled in U.S.A. in 1946 led to the discovery of 491 new oil reservoirs and new pays in existing fields, and there were 144 extensions. 150,000,000 brl of oil were added to the reserves, but 2 years or more may elapse before the real significance of these discoveries can be determined. 247 of Texas wildcats were successful. Illinois had 96 successes out of 635 tests.

Diagrams summarize the wildcat drilling activity and results during the past 5 years in the leading states. G. D. H.

1349. Poorer Reserves Increase Despite Record Output. C. J. Deegan. *Oil Gas J.*, 25.1.47, **45** (38), 154.—United States oil reserves at the beginning of 1947 were estimated to be 21,345,138,000 brl, an increase of 267,114,000 brl during 1946. 1946 discoveries added 147,110,000 brl to reserves, and extensions and revisions 1,868,772,000 brl. The 1946 production was 1,748,772,000 brl. A table gives United States reserve data by states and districts. G. D. H.

1350. New Reserves. Anon. *Oil Gas J.*, 25.1.47, **45** (38), 170.—Nearly 500 new oil pools were found in the U.S.A. in 1946, adding about 150,000,000 brl to proved reserves. The 1946 discoveries are listed according to states and districts, the following information being given : name, county, producing formation, proved acreage, formation thickness, and estimated reserves. A series of maps show the locations of the discoveries, and whether they are new fields, new pays, or extensions. G. D. H.

1351. Field Name, County, Location, and Initial Production of Discovery Wells. Anon. *Oil Gas J.*, 25.1.47, **45** (38), 200.—The U.S.A. 1946 discoveries are listed according to States, brief notes being given in each case. G. D. H.

1352. Wildcat Drilling in 1946. F. H. Lahee. *Oil Gas J.*, 29.3.47, **45** (47), 75.—During 1946 5752 exploratory wells were drilled in the U.S.A. and of these 1137 were producers. The total footage was 22,167,561 ft, the producers accounting for 5,286,711 ft.

Tables summarize the wildcat drilling results, and give numbers, depths, and results. 3795 wells were located on geological data, 615 on geophysics, and 470 on a combination of these techniques. These data also are subdivided according to States and results. G. D. H.

1353. New Kettleman Hills Producing Zone Found. Anon. *Oil Gas J.*, 1.2.47, **45** (39), 27.—Flowing production of 500–1000 brl/day of 35° gravity oil has been obtained from the Eocene sands in well 73–30V on the Kettleman Hills (California) Middle Dome. G. D. H.

1354. Middle Ordovician Limestones in Central Kansas. H. Taylor. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1242–1282.—The Middle Ordovician Viola limestones in the subsurface of north central Kansas can be separated into six member zones which are lithologically distinct. Numbered downwards, these zones are : (1) Upper limestone ; (2) Upper cherty member ; (3) Middle limestone ; (4) Middle cherty member ; (5) Lower limestone ; (6) Lower cherty or basal clastic member. The Viola is over 250 ft thick in the north, but thins to the south. Tentative correlations indicate that zones (1), (2), and (3) may be equivalent to the Stewartville, zones (4) and (5) to the Prosser and zone (6) to the Lower Prosser or Decorah formations of Iowa.

E. N. T.

1355. Sohio Discloses Oklahoma Wildcat Flowing 33 brl per hour. C. J. Deegan. *Oil Gas J.*, 1.1.47, **45** (39), 32.—1 Howard, SE SE NW 17-1n-2w, near Eola has flowed 33 brl/hr through $\frac{1}{4}$-in choke on 2$\frac{1}{2}$-in tubing from a sand in the Basal Bromide (Ordovician). The tubing pressure is 1100 p.s.i. and the G.O.R. 800 cu. ft./brl. The top of the Basal Bromide is at 10,060 ft, and the formation is 140 ft thick. There are thin oil-bearing stringers above the Basal Bromide. A test of the Pennsylvanian at 6018–6040 ft gave gas-cut mud and oil, and the Hunton at 8545–8598 ft gave similar results. G. D. H.

1356. Lindsay Play Gets Good Wells. Anon. *Oil Gas J.*, 15.3.47, **45** (45), 125.—East of the Lindsay pool in southwestern McClain County, Oklahoma, Carlock *et al* 1 Harrison, N/2 S.E. 25-5n-4w has flowed 100 brl/hr of 44° oil from the Ordovician Bromide formation at 10,430–10,440 ft and 10,445–10,485 ft. R. L. Bauman 1 Ainsworth NE NW SE 26-5n-4w gave 662 brl/day from the Hunton at 9892–9940 ft. Magnolia Petroleum Co. 1 Martin, NW NE 1-4n-5w had a commercial show at 7655–7690 ft.

The area east from Lindsay towards Pauls Valley is gradually filling up with oil-fields. G. D. H.

1357. Major Pool Looms in Oklahoma. Anon. *Oil Gas J.*, 22.3.47, **45** (46), 311.—Anderson–Prichard *et al* 1 Seaton, SE SE NW 14-2n-2w, in Garvin County, Oklahoma, has flowed 50–100 brl/hr of 42° oil from a Pennsylvanian sand at 6411–6418 ft. The well lies 3½ miles southeast of the Southwest Antioch pool and 4½ miles northwest of the Katie pool, both of which produce from the Pennsylvanian at about the same horizon. Thus there is a prospect of these two pools being connected. The Pauls Valley uplift gives a northwest nose on the flanks of which is a belt of oil-bearing Pennsylvanian sand. The width of this belt may be small, but it may continue for 10–12 miles in length. The oils of the two fields show some difference, but this may not preclude continuity of the stratigraphic type oil belt. G. D. H.

1358. Southwest Antioch–New Oklahoma Pool. R. M. Swesnik. *Oil Gas J.*, 19.4.47, **45** (50), 82.—Southwest Antioch is in southwestern Garvin County, on the west flank of the Pauls Valley uplift in the southeastern extension of the Anadarko basin. Leasing was based on the presence of a westward plunging anticlinal nose and some seismic and magnetic data. A well drilled in the centre of the SE NW 30-3n-2w found saturated sandstone at 6525–6541 ft, and was continued to the Bromide which contained water. The well was later completed in the Pennsylvanian sand zone giving about 60 brl/hr. Within a year 41 wells had been drilled, only one being dry.

The Permian and Pennsylvanian beds include red shales with occasional sand lenses and limestones which grade laterally into sandstones and shales. The producing sand, known as the Gibson, is medium grained and highly porous and permeable. Towards the base of the series is a conglomerate with pebbles possibly of Arbuckle, Hunton, and Viola limestones, and cores have shown good oil saturation in places.

Below the Pennsylvanian wells have found beds of Mississippian "Mayes" to Sylvan age. On the west side of the fault the Woodford is frequently met. In most cases the Hunton has low porosity, but bears gas.

The pre-Pennsylvanian structure is monoclinal to the west, and cut by a northwest–southeast fault downthrown by 450 ft to the west. On the east is a 100-ft fault downthrown to the east. The beds dip at about 560 ft/mile and the unconformity at 218 ft/mile. The Pennsylvanian and younger beds dip west at about 170 ft/mile and are also faulted. The Gibson sand must wedge out to the east.

The producing sand has a porosity of 15·7% and its permeability averages 300 mD. The connate water is under 15%. Gas/oil ratios are 700–1400 and the shrinkage factor is 1·6. Wells have initial potentials of 30–100 brl/hr. G. D. H.

1359. Developments in Rocky Mountain Region in 1946. E. W. Krampert. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1283–1288.—The total well footage drilled in the Rocky Mountain region increased in 1946 as compared with 1945, due to the active development of the Rangely field in northwestern Colorado. Footage drilled in Wyoming and Montana in 1946 was less than that drilled in 1945.

Oil production increased in Montana, Wyoming, and Colorado in 1946 as compared with 1945. The production increase in Colorado was 235% due to the rapid development in the Rangely field.

There were more discoveries in 1946 than in 1945 and several of them were of considerable importance. E. N. T.

1360. New East Texas Condensate Discovery. Anon. *Oil Gas J.*, 3.5.47, **45** (52), 121.—An important gas-condensate strike has been made 8 miles southwest of Jackson, in Cherokee County, Texas. The open-flow potential is 147,000,000–170,000,000

cu. ft./day with 500 brl of condensate. Production is from the Rodessa zone of the Glenrose at 8608–8630 ft. The tops of the Pettit and Travis Peak were respectively 8783 ft and 9128 ft subsea. Tests of possible pays in the James and Pettit limestones, and the Travis Peak sands gave no oil or gas. The closed-in bottom hole pressure is 4223 p.s.i. G. D. H.

1361. Seeligson May Extend Across Fault. Anon. *Oil Gas J.*, 24.5.47, **46** (3), 133.—Magnolia Petroleum Co. 1 David Clark, Section 62, R. P. Haldeman Subdivision of Seeligson Ranch (South Texas) has been completed at 4502–4510 ft in the equivalent of Zone 16 of the Seeligson field. A second well 1320 ft north missed this zone, but obtained production in Zone 22 at 5563–5572 ft. Production is 900–1000 ft higher than at the equivalent horizons in the main field to the east, and a large fault intervenes. The fault trends northeast–southwest. A further fault occurs 2 miles west of the first, possibly giving a horst. A third fault exists still farther west. Cross faults may exist in the horst.

Production is almost continuous from Agua Dulce in the north to La Gloria in the south. Recently a new pay was found at 6598 ft in the La Gloria field. G. D. H.

1362. Discovery of Rich Bitumen Deposit in Northern Canada Reported. Anon. *Oil Gas J.*, 25.1.47, **45** (38), 130.—The Mildred–Ruth Lakes area, opposite the mouth of the Steepbank River, is reported to have bituminous sands possibly containing 500,000,000 brl of liquid bitumen. The bitumen saturation ranges 12–18% by weight. The sands vary in richness, and there is inter-fingering of clay and shale bands with the sands. Thicknesses range up to 220 ft. 2 square miles of territory has been drilled on ¼–¼-mile spacing, and a larger area on ¼-mile spacing. Beds of liquid bitumen up to 21 ft thick have been met. G. D. H.

1363. Important Canadian Discovery. Anon. *Oil Gas J.*, 22.2.47, **45** (42), 190.—Imperial–Leduc No. 1, LSD 5, 22-50-6w4 has flowed about 40 brl/hr from a porous zone at 5029–5066 ft in Devonian limestone. The well is about 20 miles south of Edmonton. Previous production in east-central Alberta has been from the Cretaceous at depths of about 2000 ft. The test is about 200 miles northwest of the Steveville–Princess field where there is shallower Devonian production. There was also a gas flow and oil showings at 4000–4400 ft, and Leduc No. 2 in LSD 1, 16-50-26w4 is to be drilled because of these. G. D. H.

1364. Canada's Leduc Field Looks Good. Anon. *Oil Gas J.*, 7.6.47, **46** (5), 121.—The third well in the Leduc field, 20 miles south of Edmonton, is about to be completed. It is 1½ miles north and 1½ miles east of the discovery well. The three wells embrace an area 2½ miles from north to south, and 1¾ miles from east to west. 39° oil is obtained from a Devonian limestone at 5000–5400 ft, and the wells have open-flow capacities of about 1000 brl/day.

A well on the Jumping Pound structure is to be deepened to test the Devonian. Madison distillate production occurs at 10,000–11,000 ft on this structure.

Leduc is the most important discovery in the Alberta syncline, and the first area in the northern plains where the Devonian has been tested. 200 miles to the southeast the Devonian produces in the Steveville–Princess area at much shallower depths.

The Devonian seems to have at least two porous horizons at Leduc; the discovery well produces from the shallower and the other two from the deeper zone.

G. D. H.

1365. Highlights of Developments in Foreign Petroleum Fields. L. G. Weeks. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1135–1193.—This paper consists of a report to the annual meeting of the Amer. Assoc. Petrol. Geol. on the more important recent developments in each foreign petroleum field. The account of recent developments in most countries is prefaced by a brief statement of historic background interest.

Activity in the search for and development of petroleum has been carried on in no less than seventy countries outside the United States within recent years. The scale of these activities ranges from that of Venezuela with her more than 1,000,000 brl of daily production in 1946, to that of countries like Sweden where in a programme of

oil search in the southern part of the country, the Government completed 2 wells in the past 2 years, in one of which a showing of oil was reported.

A set of maps is given showing the sedimentary areas and the more important fields; and there are appended tables of cumulative world oil production by countries, the average daily yield for each country for 1946 and 1939, and the number of geophysical crews in operation in 1946 by countries. E. N. T.

1366. Palæogeography of South America. L. G. Weeks. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1194–1241.—The major features of the geological framework are outlined. Attention is called to the many similarities in the continental framework and geological history of South and North America. The change in palæogeography and facies from Cambrian to Pliocene times inclusive is pictured on fifteen palæogeographic facies maps, selected to show the principal sedimentary overlaps. Intervening changes and conditions, the progress of transgressions and the fundamental transitions in the architecture of the continent that caused or conditioned the palæogeographic and facies changes are briefly reviewed. E. N. T.

1367. Fourth Spring Hill Test Gets Negative Results. Anon. *Oil Gas J.*, 15.2.47, **45** (41), 61.—The fourth Spring Hill, Chile, test has been drilled to 7500 ft, 60 ft deeper than the discovery well. The results are said to be negative, although the electric log indications were good. G. D. H.

1368. Chile's Fifth Spring Hill Field Test Nears Completion. Anon. *Oil Gas J.*, 5.4.47, **45** (48), 42.—The Spring Hill producing horizon is a medium grained Cretaceous or Jurassic sand, 60–100 ft thick and lying 7350–7500 ft deep. The paraffin base oil has a gravity of 43° A.P.I. Bottom-hole pressures are 3200–3400 p.s.i.

The fifth test is expected to be completed shortly. G. D. H.

1369. Chile's Fifth Test is Big Wet-Gas Producer. Anon. *Oil Gas J.*, 12.4.47, **45** (49), 61.—The fifth Spring Hill well has been completed with a large production of wet gas. It is on the northeastern side of the structure and at a higher level structurally than the other wells. G. D. H.

1370. Sixth Spring Hill Test Down to About 5000 ft. Anon. *Oil Gas J.*, 24.5.47, **46** (3), 65.—Spring Hill, Chile, No. 6 lies about 1200 ft south of No. 3, which gave high-grade oil after first giving gas alone. G. D. H.

1371. Sixth Spring Hill Test Completed as Producer. Anon. *Oil Gas J.*, 21.6.47, **46** (7), 65.—Chile's sixth well at Spring Hill is reported to be a producer at about 7500 ft. G. D. H.

1372. Junta Petroleum Tests Deeper Sands in Wildcat. Anon. *Oil Gas J.*, 7.6.47, **46** (5), 43.—180 miles south of Barranquila, Colombia, on the west side of the Magdalena, Junta Petroleum Co's wildcat has given gas at the rate of 18,000 M.c.f. Deeper sands are being tested, and a further well is planned. G. D. H.

1373. Union Oil Stepping Up Exploration Work in Paraguay's Chaco. Anon. *Oil Gas J.*, 4.1.47, **45** (35), 32.—Union Oil Co. 1 Santa Rosa is drilling below 7348 ft in beds tentatively identified as Devonian. This well lies 255 miles west of Puerto Casada on the Paraguayan River. The site for a second well is under consideration.

A considerable amount of geophysical work has been carried out. G. D. H.

1374. On the Problem of the Geological Structure and Oil Possibilities of the Near-Caspian Depression. N. V. Nevolin. *Compt. Rend.* (*Doklady*) *Acad. Sci. URSS*, 1947, **55**, 739–741 (in English).—An analysis of new seismic data and a revision of the older geological and geophysical information are used to derive new conceptions of the geological structure and oil-bearing possibilities of the near-Caspian depression. The most promising areas for oil production are considered to be the salt-domes and the underlying structures. A map of the region, which includes Long. 45–55° E., Lat. 50° N., and contains Stalingrad, Astrakhan, the Caspian Sea, Orsk, Uralsk, and Saratow, is given with the salt domes indicated. G. H. B.

1375. Deep Test to be Spudded Soon in Northeastern Spain. Anon. *Oil Gas J.*, 19.4.47, **45** (50), 69.—A well is expected to be drilled on the Oliana structure, 15 miles east of Solsona in northeastern Spain. Eocene beds outcrop on this anticline. G. D. H.

1376. Three Companies Press Widespread Search for Oil in Egypt. W. W. Burns. *Oil Gas J.*, 8.2.47, **45** (4), 46.—Oil exploration in Egypt began in 1885, but only three commercially important fields have been found. Of these Ras Gharib, with reserves of about 100,000,000 brl, is the most important.

Anglo-Egyptian Oilfields Ltd. obtains 24,000 brl/day from Ras Gharib and 1000 brl/day from Hurghada. Ras Gharib has produced 55,000,000 brl of 25–26° oil from basal Miocene limestone and pre-Miocene sands at depths of 1500–2400 ft. It lies on an easterly-dipping monocline broken by faults in the west and below an unconformity. Hurghada has given about 40,000,000 brl of 22–24° oil from Nubian sands unconformably underlying the Miocene at depths of 1700–2200 ft.

Gemsah, discovered in 1908, has given a little oil from a basal Miocene limestone at depths of 1240–1310 ft.

The S.U.D.R. wildcat on the east coast of the Sinai Peninsula has a potential of 275 brl/day of 22° oil. It was drilled jointly by Anglo-Egyptian Oilfields and Socony-Vacuum. Oil is in a basal Miocene sandstone at 2675–2826 ft. There is a surface structure. A test at Wadi Baba was abandoned in schist at 4538 ft. The Ras Abu Radeis wildcat was in the Miocene at 6425 ft. A well is under way at Hamra, 20 miles northeast of Suez. Egyptian Standard's 1 El Khabra has reached a depth of 9981 ft.

Northern Sinai is characterized by the presence of Jurassic beds, and large asymmetric anticlines. In the Gulf of Suez area there are asymmetrical fault blocks.

In the Western Desert the Abu Roash wildcat, 4 miles west of the Pyramids, entered granite at 6250 ft. 2 Abu Roash was in limestone at a depth of 2430 ft. There are extensive outcrops of Oligocene, Miocene, and Pliocene beds. Near the Pyramids Lower Eocene, Upper Cretaceous, and Cretaceous Nubian beds come to the surface. In the desert geophysical work is necessary.

718 exploration permits each covering 100 sq. km. have been issued. G. D. H.

1377. Results Thus Far Slight in Egyptian Standard Test. Anon. *Oil Gas J.*, 12.4.47, **45** (49), 61.—The Wadi Baba test has yielded only a barrel of 8–10° oil in a drill-stem test. The well started on the downthrown side of a fault, but has unfortunately gone through the fault. G. D. H.

1378. Drilling to Begin Soon on Gaza Well, First Test in Palestine. Anon. *Oil Gas J.*, 15.3.47, **45** (45), 58.—The first well in Palestine will be drilled near Iraq Suweidan in the community of Huleiquat, 15 miles northeast of Gaza. Torsion balance and gravity meter surveys indicated a subsurface structure and this was confirmed by a seismic survey in 1946. The possibility of drilling to 10,000 ft is visualized.

A second well will be drilled in the Kurnub area in the Negev, 20 miles west of the southern end of the Dead Sea. There is a well-defined surface structure with older beds than at Huleiquat. G. D. H.

1379. New Guinea Exploration Programmes Under Way. Anon. *Oil Gas J.*, 22.2.47, **45** (42), 105.—Australian Petroleum Co. Ltd., is said to have a test in Papua which has reached 5000 ft. G. D. H.

Geophysics and Geochemical Prospecting.

1380. Exploration and the Gravity Meter. L. L. Logue and F. K. Fisk. *Oil Gas J.*, 22.2.47, **45** (42), 122.—The application of the gravity meter in the search for possible oil bearing structures is illustrated by a series of diagrams together with some descriptive text. G. D. H.

1381. Magnetic Surveys with Helicopters. H. Lundberg. *Bull. Inst. Min. Met.*, July 1947, 21–27.—The U.S. Navy's magnetic airborne detector is usually towed 100–200 ft from the aeroplane. The equipment is rather elaborate and weighs some 600 lb. Its sensitivity is ± 1–2 gamma, and the total intensity is measured. If the

airborne magnetometer is to duplicate as closely as possible results obtained on the ground, the instrument must be near the ground.

In the present work the magnetometer was flown by helicopter over known ore-bodies in the Sudbury area which had been magnetically surveyed on the ground. The magnetic detector consisted of a rotor, a stationary coil, and a compensating unit. The compensating unit neutralizes most of the earth's field and serves as a datum. The magnetic intensity variations are recorded continuously. Instrument orientation was manual, and sufficiently accurate for the experimental survey. Ground correlation was by a fully automatic timing device. The vertical intensity was measured, since this occurs directly over the magnetic body. The flying height was 150–200 ft above the ground. 28 miles of line were flown and recorded in 1 hr; the ground survey took 70 days to prepare and execute.

Comparison with the ground survey shows the same features with rather less detail, but the flying data are a satisfactory guide for exploration.

If the helicopter is taken to the point of maximum intensity and then moved sideways to a point where the intensity has fallen to a given value, a marker can be dropped at the latter point. The procedure can be repeated in the opposite direction and another marker dropped. After rising to 2000 ft above the point of maximum intensity a vertical photograph is taken showing the markers and ground features, and on this photograph the magnetic data can be plotted.

Maps and profiles show the magnetic data obtained in the ground and aerial surveys in Clermont Township, Quebec. G. D. H.

1382. Helicopter Aids Oil Search. C. J. Deegan. *Oil Gas J.*, 7.6.47, **46** (5), 61.—Gravity-meter work is being successfully executed by a helicopter in marshy areas in Louisiana, because marsh buggies were forbidden. It is believed that 600 stations per month could be covered for $15,000. Average costs per station with a marsh buggy might be $65–75.

Photographs show the helicopter in use, and the method of surveying is described. G. D. H.

1383. Airborne Magnetometer Surveys of Bahamas Soon to Start. W. W. Burns. *Oil Gas J.*, 26.4.47, **45** (51), 92.—The 50,000–80,000 square miles airborne magnetometer survey of the Bahamas will cost about $650,000. Flying lines at 2 mile intervals, the survey will occupy 6–8 months. About fifty people will be actively engaged.

A series of photographs and diagrams show some of the features of the airborne magnetometer. G. D. H.

Drilling.

1384. Discovery Well Improvement Justifies High Testing Costs. W. P. Sterne. *Oil Wkly*, 2.6.47, **126** (1), 50.—The completion of the Carter Oil Company's Eskridge No. 1 Well in Garvin County, Oklahoma, is briefly described. The data obtained by testing this well is outlined, and the importance of testing wells, especially discovery wells, is stressed. R. B. S.

1385. Workover Barges. E. H. Short, Jr. *Oil Gas J.*, 10.5.47, **46** (1), 62.—The layout and construction of specially designed workover barges for marine operations is described. These barges are being used for: (1) fishing out and resetting liners; (2) squeezing; (3) plugging back; (4) cleaning out and recompleting; and (5) placing wells on artificial lift. R. B. S.

1386. Rebuilding Worn Drag Bits. E. Sterrett. *Oil Wkly*, 12.5.47, **125** (11), 55.—Two methods of reconditioning drag bit cutting edges and the hard facing of bits are briefly discussed. R. B. S.

1387. Locating the Critical Point of Stuck Pipe or Casing. G. M. Wilson. *Oil Wkly*, 2.6.47, **126** (1), 39.—A brief description is given of a new instrument for locating the point at which a drill-pipe or casing string is stuck. The instrument employs an electronic device called a Magna-Tector, which gives an accurate indication of the amount of stretch at any point in a string of pipe. If the instrument is located above the stuck point, the elongation of the pipe, caused by a strain being taken on the

string from the surface, will be indicated by the instrument and vice versa. The complete set-up is designed so that the elongation can be read directly at the surface and as many settings or tests as desired can be made without bringing the instrument out of the hole. R. B. S.

1388. Casing Standards and Design. J. Wais, Jr. *Oil Wkly*, 9.6.47, **125** (2), 37; *Petrol. Engr*, June 1947, **18** (9), 106. (*Paper presented before Pacific Coast District Division of Production, A.P.I., Los Angeles*, Spring 1947.)—The development of new standards and the possible effect of these on casing and coupling thread design is discussed. The primary objectives of the changes under consideration by the A.P.I. are: (1) to provide more effective resistance to joint leakage at higher pressures; and (2) to obtain higher joint strength. Owing to the increasing prevalence of wash-outs and thread leaks in deep wells it has been proposed that three turns of thread may be specified instead of the nominal two to two and a half turns, and that tools and procedure be changed to permit this increase. The additional stresses involved as a result of the increased make-up and suggested improvements in the methods of testing are also discussed in this connexion. Various formulæ applicable to casing design are appended and two references are given. R. B. S.

1389. Combating Corrosion Fatigue by Plastic Coating of Drill-Pipe. L. E. Trishman. *World Petrol.*, 1947, **18** (6), 56–59.—It has been established that corrosion fatigue of drill-pipes usually starts at the inside surface. A theory is advanced to explain this; plastic coatings have been developed to reduce such corrosion. Experimental work on corrosion fatigue is described, and illustrated by photographs. F. S. A.

1390. Muffled Derricks for Residential Areas. G. M. Wilson. *Oil Wkly*, 19.5.47, **125** (12), 37.—A method of muffling derricks by the use of portable multi-layer panels is described. R. B. S.

1391. Diamond Core Drilling Methods and Problems. C. Deely. *Petrol. Engr*, June 1947, **18** (9), 98.—The development of diamond drilling methods and their adaptation to coring operations is reviewed. Two references are appended. R. B. S.

1392. Torque Converter Drives for Oil Well Drilling Rigs. Part II. C. M. O'Leary. *Oil Wkly*, 28.4.47, **125** (9), 40.—The proper gear ratios for use in connexion with torque converters are discussed: they should be so chosen that all operations can be kept within the 80% efficiency range of the converter. Automatic shifting, which can be accomplished by using a differential drive between the input and output shafts of the converter, is being developed to automatically select the proper gear ratios within the 80% efficiency range as the torque loads on the converter vary.

Overheating of the torque converter fluid gives rise to many troubles owing to gasification of the liquid: the operating efficiency of the converter, however, increases with temperature of the converter fluid until this begins to gasify, at which point the efficiency suddenly decreases. Cooling is usually achieved by radiators and cooling fans, and various combinations of these are being developed to provide automatically variable cooling in order to maintain maximum efficiency.

Although torque converters are often used for braking they are not usually designed for this purpose. For successful use as a brake, the converters should be of heavier construction and be provided with greater cooling capacity. Some systems have been developed for using converters to control the weight on the bit and for automatic drilling control: these systems have met with varying degrees of success.

A numeral example is given and the calculations necessary for selecting torque converter drives are shown. The use of torque converters in compounding pumps with maximum efficiency of operation is also discussed. R. B. S.

1393. Fishing and Cutting Technique. E. H. Short, Jr. *Oil Gas J.*, 17.5.47, **46** (2), 80.—The technique used in cutting and fishing drill-pipe from the Superior Oil Company's 51-11 Weller Well (at present the deepest well in the world) is described. R. B. S.

1394. Formation Logging. R. E. Gile. *Petrol. Engr*, June 1947, **18** (9), 93.—New methods of determining gas, oil, and water saturations in formation samples filtered from the mud stream are briefly described. This information can be continually logged, and in combination with (1) microscopic examinations of lithology and porosity, (2) records of drilling rate, (3) correlation of formation samples with depth drilled, (4) titration of solubles in the drilling fluid filtrate, and (5) routine mud tests, the nature of the formations being drilled through can be continuously studied. The use of this information is briefly discussed. R. B. S.

1395. On Neutron Well Logging by Gamma-Rays. G. V. Gorshkov and N. M. Liatkovskaya. *Compt. Rend.* (*Doklady*) *Acad. Sci. URSS*, 1947, **55**, 601–604 (in English).—Continuing previous theoretical work on this subject, the possibility of detecting and measuring gamma-rays produced in rock formations by neutrons emitted from a well-logging device has been studied experimentally. The results of work with gamma-ray and mixed neutron plus gamma-ray sources in an artificial bore-hole show that it is practically feasible to detect the gamma-rays generated in rocks by a neutron source without serious interference from scattered gamma-rays direct from the neutron source and the gamma-ray background ariaing from the natural radioactivity of granite-type rocks. The characteristics of the Geiger counter used, its response to lead screening and equations giving its response to various sources of gamma-rays involved in the present application, are described. G. H. B.

1396. Thermal Surveys Applied to Oilfield Problems. H. G. Abadie. *Petrol. Engr*, June 1947, **18** (9), 47.—Two applications of thermal logging methods are briefly described. They are: (1) a means of locating leaks in casing or tubing in a well, and (2) a means of determining a point of lost circulation in a drilling well. R. B. S.

1397. Developments in Drilling Mud Control. G. E. Cannon. *Oil Gas J.*, 3.5.47, **45** (52), 101.—Some recent developments in the filtration control of drilling muds are reviewed. R. B. S.

1398. Controlled Mud Programme at Rangely. W. B. Kimbrell. *Oil Wkly*, 2.6.47, **126** (1), 35.—The mud problems encountered in drilling in the Rangely field in Colorado are reviewed and the mud treatment programme selected to combat them is outlined. R. B. S.

1399. Oil-Base Drilling Fluid. F. M. Anderson. *Oil Wkly*, 30.6.47, **126** (5), 43.—The constitution and applications of both oil-base muds and emulsion drilling fluids are described.

Most oil-base muds consist essentially of diesel oil and asphalt blended together and compounded with a soap. The composition of the soap can be made to control the viscosity of the mud. The most suitable soap is formed by reacting sodium hydroxide, sodium silicate, and tall oil (which is a by-product obtained in the sodium sulphate process of manufacturing kraft paper from the jack pine) within the diesel oil–asphalt medium. The mud viscosity can be lowered by increasing the amount of tall oil, and can be raised by increasing the amount of sodium silicate. Oil-base muds are especially advantageous for completing low pressure or highly impermeable sands and in obtaining better core data owing to its zero water content. In many cases they prevent heaving shale from entering the hole and aid in improving cement jobs. Also they are not seriously affected by drilling salt sections and zones where hot salt water is encountered.

Emulsion drilling fluids, which are an emulsion of an oil-base mud and an ordinary bentonic water-base drilling fluid, are being increasingly used. This type of drilling fluid has similar applications to the oil-base muds with the exception of drilling salt sections. In addition it is electrically conductive and good electric logs can be obtained when using ordinary electric logging instruments in emulsion drilling fluid. R. B. S.

1400. Selection of Mud Fluid for Completion of Wells. H. E. Radford. *Petrol. Engr*, June 1947, **18** (9), 72. (*Paper presented before Pacific Coast District, Division of Production A.P.I., Los Angeles*, May 1947.)—The selection of a drilling mud for com-

pletion work is based on considerations to obtain the maximum productivity for the particular well. Each of the several special muds available have certain advantages that may result in their selection for a particular well completion. The characteristic advantages of several types of muds are reviewed, and examples are given of their use under appropriate circumstances.

Eight references are appended. R. B. S.

1401. Movement of Water–Oil Interface and Water Encroachment into Wells under Hydrostatic Head. B. E. Kazarnovskaya. *Compt. Rend.* (*Doklady*) *Acad. Sci. URSS*, 1947, **55**, 689–692 (in English).—This paper is a theoretical treatment of the hydrodynamics of a system comprising an oil reservoir extending ribbon-wise to a great length with arrays of wells following the same direction and with a parallel supply boundary. The oil-bearing stratum is supposed to be plane, slightly inclined to the horizon and the wells drilled at right angles to it. Each well is supposed to have its production rate distributed uniformly along its height. Equations are derived which describe the encroachment of an oil–water interface into the array of wells from below the reservoir, the rate of water production, and the shape of the oil–water boundary. G. H. B.

Production.

1402. Organization Elements : Their Relation to Oil and Gas-Producing Operations. J. E. Toussaint. *Oil Wkly*, 9.6.47, **126** (2), 41. (*Paper presented before Pacific Coast District Division of Production A.P.I., Los Angeles*, May 1947.)—The fundamentals of organization of oil- and gas-producing operations are discussed. R. B. S.

1403. Doubling Shaft Operating Life by Metallizing and Truing. E. Sterrett. *Oil Wkly*, 19.5.47, **125** (12), 44.—The procedure to be followed in metallizing and truing compressor shafts for repressuring and recycling plants is outlined. R. B. S.

1404. Case Histories of Mud Acidization. (Engineering Fundamentals No. 284.) Anon. *Oil Gas J.*, 3.5.47, **48** (52), 109.—Details are given of mud acidization operations in : (1) a gas injection well in the Slick sand, South Texas, (2) a pumping well in the Miocene sand, South Texas, and (3) a salt water disposal well in the Gulf Coast area.

This article concludes a series of seven instalments on "Mud Acidizing" (see Abstracts Nos. 1016, 1029, 1027, 1265, 1266, and 1267 (1947)). R. B. S.

1405. Control of Unconsolidated Sands in Wilmington Oilfield. R. Winterburn. *Petrol. Engr*, June 1947, **18** (9), 80. (*Paper presented before Pacific Coast District Division of Production, A.P.I., Los Angeles*, May 1947.)—Details are given of the performance and economics of several wells in the Tar, Ranger, and Upper Terminal Zones in the Wilmington field, which were completed in various ways. The comparative advantages and disadvantages of these various completion methods are also discussed. Six references are appended. R. B. S.

1406. Secondary Recovery in the Delaware–Childers Area. K. H. Johnston and C. H. Riggs. *Oil Wkly*, 12.5.47, **125** (11), 57. (*Abridged version of U.S. Bur. Mines, Rep. Invest. No.* 4019.)—The discovery and development of the Delaware–Childers field in Nowata County, Oklahoma, is briefly reviewed. The air and gas injection practices and the production methods employed are also discussed. R. B. S.

1407. New Deep Well Cementing Unit. W. D. Owsley. *Oil Wkly*, 9.6.47, **126** (2), 31.—A description is given of a new oil well cementing unit which is specially designed so as to obtain greater pumping pressures and quicker mixing and displacement of the cement slurry. R. B. S.

1408. Corrosion. B. J. Cotey. *Oil Gas J.*, 10.5.47, **46** (1), 68.—The use of a new chemical method of treating wells for corrosion inhibition is described. The inhibitor builds up a protective film on the surfaces with which it comes in contact ; after this

film is once established the inhibitor can be used intermittently, once every few days. Three examples are given of wells in which the method was used successfully.
R. B. S.

1409. Economics of Dual Wells in Waskom Field. K. M. Fagin. *Petrol. Engr*, June 1947, **18** (9), 120.—Data are presented on the development and production of the Waskom gas field in Harrison County, Texas. The method of making the dual completions and the advantages gained thereby are also discussed. R. B. S.

1410. Application to Cycling of Gas Injection Below Normal Gas Water Contact. H. L. Hensley. *Oil Gas J.*, 3.5.47, **45** (52), 84.—Details are given of several cycling projects in which recycled gas is injected through edge wells completed below the normal gas-water contact. The method has been found equally successful for sands of varying permeability. R. B. S.

1411. Thermodynamics of Gas-Lift Oil Production. W. C. Edmister and R. J. McGarry. *Oil Wkly*, 30.6.47, **126** (5), 61.—The fundamental concepts of gas-lift production are discussed and examples are given of calculations for the design of gas-lift equipment. R. B. S.

1412. Carthage Field Gas Proration. S. Smith. *Oil Wkly*, 2.6.47, **126** (1), 42.—Proration in the Carthage Field, Texas, is discussed. R. B. S.

1413. A Study of Some Factors Affecting Gun Perforating. S. C. Oliphant. *Petrol. Tech.*, Jan. 1947, **10** (1); *A.I.M.M.E. Tech. Pub. No.* 2115, 1–13.—In the subsurface tests 65 ft of 5-in casing centred inside 7-in casing and cemented with neat cement was lowered to 6000 ft on 5½-in casing, the hole being filled with drilling mud. Perforating companies were asked to check the total depth to cross-pins at the bottom of the test section, and to place shots at given distances above this point. Appreciable errors in the amount of pick-up were found, even though the greatest pick-up distance was only 50 ft. The total depths measured ranged 6593·5 ft to 6599 ft, the casing tally being 6600 ft. The test section after recovery was also examined for penetration. Few of the standard shots penetrated both strings. Similar results were obtained at the surface when perforating guns were used on blank portions of the test section taken from the well.

In laboratory tests the effects of the following factors were studied: powder charge, wet powder, gun size, the use of shear discs, bullet shape and size, gun wear, and bullet sleeves or bushings. The best penetrations were obtained with the largest gun that could be safely run inside the pipe to be perforated. The optimum bullet size was usually 0·3–0·5 in diameter, but penetration depended on the type of formation. Standard conical and ogival bullets had similar penetrations. Worn gun barrels gave lower penetrations than new barrels.

It is not certain that all bullets fired by existing perforating services will completely penetrate even one string of casing and the surrounding cement. Those fired through casing and neat cement into various formations showed deep striations on both nose and base. Bullets giving reduced casing burring seem to sacrifice penetration. It appears that most cases of split casing in perforating may be due to poor cement jobs, perforating under fluid, and using large bullets.

Cement perforated too soon gives a large hole, and that perforated after prolonged ageing suffers much cracking and shattering. Mineral grains adjacent to the bullet's path are crushed and compacted, and the permeability was reduced by 40–80% of its original value, the greater reduction taking place in the less permeable formations.
G. D. H.

1414. New Method for Measurement of Oil Saturation in Cores. R. L. Boyer, F. Morgan, and M. Muskat. *Petrol. Tech.*, Jan. 1947, **10** (1), *A.I.M.M.E. Tech. Pub. No.* 2124, 1–19.—A technique is described for measuring the oil saturation in cores through which two fluids are flowing. A substance, such as iodobenzene, is dissolved in the oil, and this substance causes appreciable absorption of X-rays passing through the core. The experimental arrangement makes use of an X-ray source and a saturated

core in addition to that under test, together with ionization chambers to permit the measurement of the intensities of the X-ray beams after passage through the tubes.

In order to explore the possibilities of the method experiments were carried out on the effect of gas-flow reversal on oil distribution in cores without interstitial water, on oil- and water-flooding of saturated cores, and on gas-drive in horizontal cores. The results of these experiments are described, and the method is discussed in considerable detail. G. D. H.

1415. Extending the Application of Electric Analogy in Oil Reservoir Studies. H. Schaefer. *Petrol. Tech.*, Jan. 1947, **10** (1), *A.I.M.M.E. Tech. Pub. No.* 2125, 1–7.—The solution by electrical analogy of performance problems of reservoirs containing oil and gas has hitherto depended on a process of successive approximations based on material balance calculations, because of variation in fluid compressibility. By adding or subtracting electrical condenser capacity the electrical analogy network can be adjusted automatically to allow for changes in compressibility caused by evolution of gas.

A description is given of the electronic circuit required for adding a condenser. The subtraction of a condenser is achieved simply by opening an electrical circuit by means of a relay.

The performance curves of several fields are given, together with the pressure curves predicted by the electrical analogy technique. G. D. H.

1416. Estimating Interstitial Water by the Capillary Pressure Method. O. F. Thornton and D. L. Marshall. *Petrol. Tech.*, Jan. 1947, **10** (1), *A.I.M.M.E. Tech. Pub. No.* 2126, 1–9.—The interstitial water content of cores can be measured by the capillary pressure method, and data so obtained are compared with water saturations measured in cores cut with oil-base muds, and with values computed from the electrical resistivity of the formation. The general agreement of the values obtained by capillary pressure and other methods indicates that the method can yield results which are sufficiently accurate for most oilfield engineering purposes. In some instances it may be possible to extend the utility of data obtained by the capillary pressure method by correlation of interstitial water saturation with more easily measured properties of the media such as permeability or electrical resistivity. G. D. H.

1417. Use of Plastics in Consolidating Loose Sands in Wells. R. H. Smith and A. C. Polk. *Petrol. Tech.*, March 1947, **10** (2), *A.I.M.M.E. Tech. Pub. No.* 2147, 1–7.—The production of oil from loose sands presents many problems, and recently plastics have been applied to bind the sand without seriously reducing the permeability. In this way "sanding up" and excessive wear of equipment are reduced.

The plastic must penetrate the sand under a low pressure differential. It must have adequate compressive and tensile strength. When set the plastic must be permeable.

The operation of injecting sand consolidating-plastic is carried out by the squeeze technique. For 30-in penetration with 30% sand porosity in a well with 7-in casing about 170 gal of plastic is needed for each 10 ft of sand thickness.

Some 150 wells have been treated with plastic, and 80% have been successful. Bottom-hole temperatures have ranged 105–350° F. G. D. H.

1418. Plastic Used to Consolidate Incompetent Formations. P. H. Cardwell. *Petrol. Tech.*, March 1947, **10** (2), *A.I.M.M.E. Tech. Pub. No.* 2148, 1–6.—To ensure permeability after treating a sand with plastic for consolidation purposes it has been suggested that excess plastic should be flushed back into the formation or it should be flushed into the well by producing the well before the plastic has set. At times it is difficult to remove excess plastic in these ways.

An alternative method of ensuring permeability is to use a plastic which shrinks considerably in setting. The shrinkage should be at least 30% and preferably more. The most successful plastics have liquid volumes 1·4–2·5 times greater than the volume of the resultant solid.

Plastics used in sand consolidation are of the thermo-setting type, the heat being supplied by the well. The setting time depends on the nature of the plastic, the temperature and other factors. Catalysts may be used to increase the rate of polymerization. The plastics used are inert and not affected in any way by water, oil, or

gas. The viscosities of the liquid plastics are only slightly above that of water. The interfacial tension between the liquid plastics and brines or crude oils is about 1–3 dynes/cm.

Most producing unconsolidated sands have high permeabilities and hence a permeability reduction of 50–70% is not prohibitive. The plastic displaces oil and water from the sand, giving a good bond. G. D. H.

1419. Volumetric Behaviour of Oil and Gas from Several San Joaquin Valley Fields. B. H. Sage and R. H. Olds. *Petrol. Tech.*, March 1947, **10** (2), *A.I.M.M.E. Tech. Pub. No.* 2153, 1–18.—The formation volume and volume of the liquid phase and gas obtained from four fields in the San Joaquin Valley have been determined at pressures, temperatures, and gas–oil ratios comparable with those met in the reservoir rocks. The produced gas–oil ratio in each case exceeds 5000 cu. ft./brl, and the gravity of the tank oil ranges 52° to 63° A.P.I. Tables give the results obtained, together with analytical data on the oil and gas composition. Rough correlations between formation volume and pressure, temperature and gas–oil ratio, and between retrograde dew-point pressure, gas–oil ratio, temperature, and tank oil gravity are presented. No simple correlations were found between the formation volume of the liquid phase and one of the other variables. The correlations are considered to be applicable only over the range of conditions used in the experimental work, and for systems of similar nature and composition. G. D. H.

1420. Calculated Recoveries by Cycling from a Retrograde Reservoir of Variable Permeability. M. B. Standing, E. N. Lindblad, and R. L. Parsons. *Petrol. Tech.*, May 1947, **10** (3), *A.I.M.M.E. Tech. Pub. No.* 2200, 1–26.—The recovery of the heavier components from a gas cap or retrograde pool is shown to be greatest when dry gas at a low pressure is reinjected into the sand. This conclusion is directly opposed to the usual belief that the most efficient production technique is one of pressure maintenance and cycling at or near the dew-point.

In making calculations the following data were employed: (*a*) constant volume, variable composition pressure–volume–temperature tests on a mixture of trap gas and liquid from a producing well; (*b*) published equilibrium constant data and the measured composition of the dew-point material; (*c*) the fact that in a sand section of uniform permeability injected gas displaces reservoir gas nearly completely.

The results are derived by making the simplifying assumption that variable permeability systems may be defined by the ratio of two statistical parameters, and that gas injected into an actual sand will behave as though the sand were composed of many layers, each of constant permeability. G. D. H.

1421. Some Theoretical Aspects of Well Drainage and Economic Ultimate Recovery. V. Moyer. *Petrol. Tech.*, May 1947, **10** (3), *A.I.M.M.E. Tech. Pub. No.* 2201, 1–14.—A method of studying reservoir behaviour is presented in which well-bore pressure drawdown effects are incorporated. Examples are given indicating the use of this factor for relating sand thickness and permeability to economically producible reserves, determining the effect of well-bore permeability damage on economic ultimate recovery and productivity index, investigation of well-spacing in simple reservoirs, and for indicating the long-range variation of productivity index with rate.

The study is not without its limitations, and further investigations may possibly reveal other factors and invalidate some of the assumptions made, thereby rendering incorrect some of the conclusions now drawn. G. D. H.

1422. Some Aspects of High Pressures in the D-7 Zone of the Ventura Avenue Field. E. V. Watts. *Petrol. Tech.*, May 1947, **10** (3), *A.I.M.M.E. Tech. Pub. No.* 2204, 1–15.—The original reservoir pressure in the D-7 zone of the Ventura Avenue field at 9200 ft was nearly equal to the pressure of the overburden. This is the first case of this type observed in California, although this phenomenon has been met elsewhere. Various hypotheses have been put forward to explain these high pressures: (1) the inability of the reservoir rock to support the overburden; (2) sealing of the reservoir at a time of substantially deeper burial; (3) tectonic forces; (4) compaction of shales interbedded with sandstones. Compaction seems to be the most likely source of the high pressure in the D-7 zone.

The oil in the D-7 zone is undersaturated with gas. At pressures above the bubble-point oil is driven out of the reservoir through wells by the slight expansibility of the reservoir framework and its liquid contents. It has been calculated that this mechanism will provide 110 brl/acre-ft.

The principal production problems are concerned with the handling of asphaltenes, paraffin wax, and sand produced with the oil. These bridge the tubing or plug the surface bean.

Due to low permeabilities and high pressures big pressure differentials are set up in producing at rates which tend to reduce certain troubles. Frequent cases of pipe failure are known, and these are attributed to the high pressure conditions and compaction of the sediments. G. D. H.

1423. New Electrical Logging Techniques in California. J. C. Stick, J. S. Baker, and R. G. Norelius. *Oil Gas J.*, 17.5.47, **46** (2), 82.—In California certain fields have relatively high resistivity formation waters, and hence small salinity changes lead to wide resistivity variations. Some freshwater sands may show higher resistivities than associated oil sands. This has rendered interpretation difficult, and attempts to solve the problem by varying the mud salinity in order to give changes in the S.P. curve have been helpful, though not conclusive.

A water sand has higher permeability to water invasion than an equivalent sand with low interstitial water content. Drilling mud filtrate invades formations in an amount and to a depth which seem to be related to the water permeability. The depth of invasion is determined by making a series of shallow penetration resistivity curves. The hole effect is dependent on hole size and the ratio of formation and mud resistivities. The hole effect is also indirectly dependent on water permeability since filtration alters the formation resistivity. Graphical methods have been developed for correcting for the borehole effect. The change in resistivity will be proportional to the ability of the formation to take filtrate. The method is discussed in detail.

Logging in oil-base muds is complicated by oil invasion and the presence of an insulating filter-cake. Electrodes in the form of a circular wire brush have been used, but spring-loaded cutting blades may be superior. However, early oil-base logs were made up of an S.P. curve, and a resistance curve on which were superimposed the effects of random contact resistances. Intermittent electrode contact also interfered. Improvements have been made by increasing the number of cutters and their sharpness. This has given more uniform current, and so the curves more nearly resemble those obtained with ordinary mud. The jaggedness of the logs has been reduced by electrical filters. Some features associated with the interpretation of oil-base logs are described. G. D. H.

1424. Oilfield X-Ray. Anon. *Petrol. Engr*, June 1947, **18** (9), 53.—The applications of a new X-ray apparatus for determining permeability–saturation data are briefly discussed. No technical information is given on the apparatus itself. R. B. S.

1425. The Flow of Homogeneous Fluids Through Ideal Porous Media. Part I. J. C. Calhoun, Jr., and S. T. Yuster. *Producer's Monthly*, May 1947, **11** (7), 31. (*Paper presented before A.P.I., Chicago*, Nov. 1946.)—The purpose of the authors' research is (1) to investigate the flow of gases at various mean pressures, at various temperature gradients, and at various temperatures; (2) to investigate the flow of pure liquids at various total pressures, at various pressure gradients, and at various temperatures; (3) to correlate the flow of gases with that of liquids; (4) to investigate the flow of solutions containing solutes of varying molecular complexity, absorbability, surface energy, ionizability, and similar such properties which are known to give rise to anomalous behaviour; and (5) to correlate the flow of these various solutions with that of pure liquids. During the work attempts were made to use only such porous media as were inert as possible to any effects (*e.g.*, clay swelling due to an imbibition of water) which would change the structure of the media during the experiments.

In this part the author discusses previous work on the subject and also shows that equivalent permeability values should exist for the same gas at two different temperatures T_1 and T_2 provided that $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ where P_1 and P_2 are the pressures in the first and second cases respectively. R. B. S.

1426. Selective Plugging by Chemical Methods. H. C. Lawton. *Oil Wkly*, 19.5.47, **125** (12), 46.—See Abstract No. 225 (1947).

1427. Pressure Maintenance in Rincon Field. N. Williams. *Oil Gas J.*, 24.5.47, **46** (3), 80.—A description is given of the Continental Oil Company's pressure maintenance plant in Rincon Field, Starr County, Texas. One reference is appended. R. B. S.

1428. Crude Stabilization for Production Gain. J. G. Coultrup. *Oil Wkly*, 16.6.47, **126** (3), 36.—The author discusses the advantages and disadvantages of crude stabilization as an alternative to natural gasoline production: the term "crude stabilization" infers the separation (at relatively higher separator pressures) of a "dry" gas and a crude of high (A.P.I.) gravity (*i.e.*, low S.G.). Among the advantages of crude stabilization are: (1) the higher separator pressures and more fluid crude enable small diameter lines to be used with consequent savings; (2) reduction of gas compressor horse-power requirements due to the higher separator pressures; and (3) the production of a higher quality oil. The disadvantages are: (1) increased lifting costs on artificial lift wells due to higher separator pressures; (2) the restrictions imposed on artificially flowing wells (particularly evident in low-pressure fields); and (3) the increased cost of segregating wet oil or alternatively treating the entire crude stream. Another consideration is the fact that the lower separator pressures associated with gasoline extraction do effectively reduce subsequent evaporation losses in treating, storage, and transportation of the crude. R. B. S.

1429. Advantages of Brines in Secondary Recovery of Petroleum by Water-Flooding. R. V. Hughes and R. J. Pfister. *Petrol. Tech.*, March 1947, **10** (2), *A.I.M.M.E. Tech. Pub. No.* 2127, 1–15.—In order to obtain good oil recoveries from low permeability sands by water-flooding adequate water-input rates are necessary. In the early days of water-flooding the addition of soda ash and caustic soda to fresh input waters was recommended and tried without success in the Bradford field. One of the commonest difficulties was plugging of the sand, and laboratory work has shown decreasing fresh-water permeabilities for sand cores with time of flooding. It was believed that this phenomenon might be partly explained by swelling of clays in the sands. Accordingly, the use of natural or artificial brines for water-flooding has been suggested.

The literature bearing on the above problem is reviewed and the results of laboratory work are presented. These studies show that soda ash and caustic soda are not good additives, and indicate that the physical and chemical properties of input-water in secondary recovery operations should be such as to keep the clay content of the sand permanently flocculated. Produced brines satisfy this requirement, and their use is recommended as a means of increasing intake rates and oil recoveries in tight sands. Moreover, this affords a solution of the brine-disposal problem and conserves a natural resource. G. D. H.

1430. Designs for Oilfield Tools to Aid in Water-Flooding. F. Squires. *Oil Wkly*, 5.5.47, **125** (10), 50.—A description is given of three new oilfield tools to solve the problems encountered in water-flooding. These are (1) the shot-hole caliper, (2) the shot-hole core-drill, and (3) the rotor valve.

The shot-hole caliper is an improved tool for determining shot-hole profiles: this information is needed in developing the permeability profiles of old wells required for water injection purposes. The shot-hole core drill has been designed to enable cores to be taken from the sides of shot-holes in old wells and is so designed that it is possible to cut several cores without withdrawing the tool from the well. The tool can be run on a standard pulling machine and the cores are cut by a high speed diamond drill operated by an electric, air driven, or turbine motor. The rotor valve is a device for measuring and regulating the amount of water entering an oil sand from a top water sand. R. B. S.

1431. Oil Production by Water. Part 19. An Elongated Reservoir. P. J. Jones. *Oil Gas J.*, 3.5.47, **45** (52), 90.—The characteristics of a hypothetical elongated reservoir, termed the E-1 reservoir, are mapped out in detail: methods are then shown for estimating the productive capacity and cumulative recovery by water encroachment of the E-1 reservoir. R. B. S.

1432. Oil Production by Water. Part 20. Location and Spacing of Wells on Elongated Reservoirs. P. J. Jones. *Oil Gas J.*, 10.5.47, **46** (1), 87.—A method is shown for determining the optimum location and spacing of producing and injection wells on elongated reservoirs: an example of the method is given based upon the characteristics of the E-1 reservoir described in Part 19. The theoretical results lead to the general conclusion that the smaller the ratio of minor to major axes, the greater the tendency for water to reach the producing wells via minor semi-axes, unless offset by gravity and the proper location of producing and injection wells. This article concludes the series on "Oil Production by Water" (see Abstracts Nos. 232, 359, 372, 559, 560, 561, 562, 563, 564, 1039, 1040, 565, 1041, 1042, 1166, 1167, 1168, 1274, 1431 (1947)). R. B. S.

1433. Water Treating for Secondary Recovery. P. DeLozier. *Oil Wkly*, 26.5.47, **125** (13), 53.—The importance of treating raw water for flooding operations is stressed. The water-treating plant should be properly designed on the basis of water analyses, and a constant supply of raw water should be available so as to avoid the necessity of altering the treating plant and procedure. Tests should be made at intervals to ensure that the water is stable and suitable for injection. R. B. S.

1434. Water Flooding Research is Essential. D. Scott, Jr. *Producer's Monthly*, May 1947, **11** (7), 27. (*Paper presented before Eastern District Division of Production, A.P.I., Pittsburg*, April 1947.)—The development of secondary recovery operations in the Bradford Field and the salient features of progress in water-flooding research are outlined. R. B. S.

1435. Chemical Agents in Water-Flooding. P. L. Terwilliger and S. T. Yuster. *Oil Wkly*, 2.6.47, **126** (1), 54. (*Paper presented at 10th Annual Secondary Recovery Conference, School of Mineral Industries, Pennsylvania State College.*)—See Abstract No. 819 (1947).

1436. Effect of Dissolved Iron in Oilfield Water-Flood. Anon. *Oil Wkly*, 9.6.47, **126** (2), 48.—The deleterious effects of dissolved iron in flood waters are discussed and the methods of removing iron depositions and of reducing iron content are briefly reviewed. R. B. S.

1437. Hazards of Experimental Water-Flooding. F. R. Cozzens. *Oil Wkly*, 23.6.47, **125** (4), 45.—Among the undesirable effects of water-flooding are: (1) bypassing and channeling; and (2) conveyance into the sand of silt, mineral salts, oxides, and bacterial growth. These are each discussed and methods of overcoming them are briefly reviewed. R. B. S.

1438. Phase Relations of Hydrocarbon–Water Systems. J. J. McKetta and D. L. Katz. *Petrol. Tech.*, Jan. 1947, **10** (1), *A.I.M.M.E. Tech. Pub. No.* 223, 1–9.—Recent experimental data on the methane-*n*-butane–water system have been combined with published information to give the water vapour content of natural gases, the solubility of water in hydrocarbon liquids, and the solubility of natural gases in water. Dissolved salts reduce the concentration of water in the equilibrium gas phase below that for pure water. Water dissolved in hydrocarbon condensate may be a vital factor in tubing corrosion. G. D. H.

Oilfield Development.

1439. World Productions. W. W. Burns. *Oil Gas J.*, 25.1.47, **45** (38), 157.—At the end of 1946 crude oil production outside the U.S.A. averaged 3,169,000 brl/day, about 50% more than in 1938. A table gives the daily output in 1938 and 1946 for countries other than the U.S.A., and the oil position in various countries is discussed. G. D. H.

1440. 1947 Drilling Footage Will Establish All-Time Record. Anon. *Oil Gas J.*, 25.1.47, **45** (38), 136.—Over 30,000 wells and nearly 107,000,000 ft of drilling are planned in the U.S.A. for 1947. 11·4% more exploratory wells are expected to be drilled than in 1946, and 1·2% more development wells.

The 1947 forecasted drilling in each State and district is given, together with the change from the 1946 drilling. G. D. H.

1441. 29,000 Wells Drilled in 1946 Despite Post-war Maladjustments. Anon. *Oil Gas J.*, 25.1.47, **45** (38), 138.—During 1946 29,228 wells were completed in the U.S.A., 24,710 being development wells and 4518 wildcats. Of the development wells 15,126 found oil, and 2963 found gas. 635 wildcats found oil and 127 found gas.

Tables summarize the wildcat and development well completion results by States and districts. The numbers of service wells are given. Further tabulations give the drilling and producing depth records in each State. G. D. H.

1442. Depth Trends Showed Wide Variation by Districts. Anon. *Oil Gas J.*, 25.1.47, **45** (38), 142.—97,068,000 ft was drilled in the U.S.A. in 1946 in oil and gas fields. The average footage per well was 3321 ft. Average depth and footage trends in leading States are shown graphically for the past 6 years. G. D. H.

1443. Peacetime Production Exceeds That at Peak of War. C. J. Deegan. *Oil Gas J.*, 25.1.47, **45** (38), 150.—1,748,772,000 brl of oil were produced in the U.S.A. in 1946, 37,669,000 brl more than 1945. Louisiana had the biggest rise in production (21,042,000 brl). The leading States in order of decreasing output were Texas (764,593,000 brl), California (316,606,000 brl), Louisiana (151,608,000 brl), Oklahoma (137,228,000 brl), Kansas (96,579,000 brl), and Illinois (74,613,000 brl).

Nearly 51% of the Texas output comes from 20 pools, and 8 pools accounted for nearly half of California's output.

A table gives the yearly output from 1941 by States. G. D. H.

1444. Production and Reserves of U.S. Major Fields. Anon. *Oil Gas J.*, 25.1.47, **45** (38), 152.—A table gives the yearly output from 1942, the cumulative production to the end of 1946, and the remaining and ultimate reserves for the U.S. oilfields estimated to have ultimate yields of 100,000,000 brl or more. These fields gave 50·4% of the 1946 output, have given 54·5% of the output to the end of 1946, and are thought to possess 64·7% of the remaining U.S. reserves. G. D. H.

1445. Annual and Cumulative Production, Remaining Reserves by Fields. Anon. *Oil Gas J.*, 25.1.47, **45** (38), 191.—The following data are tabulated by fields grouped according to districts within States: 1946 production, cumulative production, number of wells, and estimated reserves at January 1, 1947. G. D. H.

1446. Exploratory and Development Drilling—Where it Occurred and the Results. Anon. *Oil Gas J.*, 25.1.47, **45** (38), 241.—Tables summarize 1946 drilling results, by months and fields, grouped according to States, and whether wildcat or development. The total completions and footage are listed, as well as the numbers of oil, gas, and dry wells. G. D. H.

1447. Southeastern States Total Reserves Nearing Half Billion Brl Mark. A. M. Crowell. *Oil Gas J.*, 24.5.47, **43** (3), 96.—In the southeastern States reserves have been estimated as follows: Alabama 9,000,000 brl oil, 200,000,000 cu. ft. gas; Florida 13,000,000 brl oil, 1,000,000,000 cu. ft. gas; Mississippi 401,000,000 brl oil, 3,074,300,000,000 cu. ft. gas. Currently Mississippi produces 88,000 brl/day, although the maximum efficient rate is under 59,000 brl/day.

Tables give the estimated producible reserves and daily availability by fields, as well as the basic reservoir data and cumulative production to the beginning of 1947. G. D. H.

1448. The Delhi Field To-day. O. W. Willcox. *World Petrol.*, 1947, **18** (7), 41–45.—General knowledge of the regional geological structure led to drilling in the Delhi field (northeast Louisiana). The area is divisible into the Delhi, West Delhi, and Big Creek fields. Some geological data and sketches are given. Murphy–Sun interests are constructing, 2 miles west of Delhi, a natural gasoline plant of which a brief description is given. Production from the area to the end of 1946 was over 7 million brl. The eventual total yield is estimated as 200 million brl. F. S. A.

1449. Production Outside U.S. Due to Reach 3,211,000 brl in 1947. W. W. Burns. *Oil Gas J.*, 22.3.47, **45** (46), 140.—Oil output outside Russia is expected to reach 2,610,000 brl/day in 1947, compared with an average of 2,345,000 brl/day in 1946.

Last year Middle East production was 604,500 brl/day compared with 538,800 brl/day in 1945. In 1946 Iran gave 403,100 brl/day, Saudi Arabia 164,400 brl/day, Iraq 96,700 brl/day. Venezuela gave 1,064,900 brl/day in 1946 and 885,921 brl/day in 1945. During 1946 Colombia produced 60,600 brl/day and Mexico 35,000 brl/day. Russia's 1946 output is thought to have been 450,000 brl/day, and the Dutch East Indies with British Borneo provided 35,000 brl/day.

The 1946 daily outputs and the 1947 estimated outputs are tabulated for the various producing areas. G. D. H.

1450. Petroleum Supply Problem is World Wide : Nearby Markets to Take Middle East Oil. L. F. McCollum. *Oil Gas J.*, 17.5.47, **46** (2), 62.—Possible areas of important future oil development outside the U.S.A. include the Caribbean fringe, east of the Andes in Colombia, Peru, and Ecuador, the Middle East, Oceania, and Russia. At present the western hemisphere supplies 82% of the world oil output.

Currently Venezuela produces 1,174,000 brl/day, which is an annual rate of 5·7% of the reserves. The Middle East gave 702,000 brl/day in 1946, and in 1947 the rate will probably be 806,000 brl/day. The reservoirs are predominantly limestones, and potentials are high. The Kirkuk field is 60 miles long and 2¼ miles wide. Some 50 wells have been drilled, but only 16 are used for production. It is possible that in the Middle East annual output does not exceed 3½% of the reserve.

The islands of the Far East gave 180,000 brl/day before the war, but at present yield only 35,000 brl/day. The Far East reserves amount to 1,300,000,000 brl, and the output could be raised to 180,000 brl/day with safety.

It is not considered that any substantial volume of Middle East crude could find a market in the U.S.A. under present conditions. Excluding Russia it is estimated that world supplies of oil in 1947 will be 7,895,000, and they will rise to 9,429,000 brl/day in 1951. No important excess producing capacity seems likely to exist during the next 5 years.

Tables give data on production, reserves, and availability of oil. G. D. H.

1451. Pemex Steps up Output from Isthmus Fields. Anon. *Oil Gas J.*, 15.3.47, **45** (45), 61.—The daily output of the fifteen small fields around Minatitlan has risen from 12,000 to 17,000 brl/day. Only 25 wells flow there, and that is the only area of Mexico where artificial lift is undertaken. Nine wildcats are to be drilled in the Isthmus area in 1947. G. D. H.

1452. Argentina's 1946 Crude Output Down, Imports Up. Anon. *Oil Gas J.*, 7.6.47, **46** (5), 43.—During 1946 Argentina produced about 21,000,000 brl of oil. The 1945 figure was 23,300,000 brl. In 1946 Comodoro Rivadavia gave 14,592,000 brl, Plaza Huincul 2,266,000 brl, Mendoza 3,049,000 brl, and Salta 1,017,000 brl. G. D. H.

1453. Bolivia Planning 22 Development Wells in Camiri Field. Anon. *Oil Gas J.*, 3.5.47, **45** (52), 44.—In deepening a well abandoned as dry in 1931, a new oil-bearing horizon was struck at 1643 ft. This well lies 2 miles from producing wells at Camiri and is generally regarded as proving an extension of the Camiri producing area. 22 wells are expected to be spudded at Camiri during 1947, and a further 28 are planned for 1948.

It is expected that a wildcat will be drilled in the Guayruy area near Camiri. G. D. H.

1454. Brazil's December Crude Output Set at 6233 Brl. Anon. *Oil Gas J.*, 15.3.47, **45** (45), 61.—In December Brazil produced 6223 brl of oil, 5862 brl coming from the Candeias field. G. D. H.

1455. Colombia's 1946 Output Down Due to Strike. Anon. *Oil Gas J.*, 1.3.47, **45** (43), 45.—Colombia's daily output averaged 61,434 brl in 1946 and 62,600 brl in 1945. In 1946 the De Mares concession exported 8,970,487 brl, Barco 6,153,533 brl, and Yondo 2,897,427 brl.

The Sardinata test was abandoned at 8250 ft in January, and a second test is to be drilled 7 km south. The Zahino wildcat was coring at 5992 ft in February.
G. D. H.

1456. Decline Shown in Peru's 1946 Crude Production. Anon. *Oil Gas J.*, 5.4.47, **45** (48), 43.—During 1946 Peru produced 12,455,991 brl of oil, and in 1945 13,748,228 brl. The 1946 natural gasoline production was 1,041,536 brl. G. D. H.

1457. Peruvian Production at 34,400 brl Daily. Anon. *Oil Gas J.*, 21.6.47, **46** (7), 65.—Peru produced 3,104,593 brl of oil in the first quarter of 1947. For the same period in 1946 the output was 3,181,457 brl. G. D. H.

1458. Peru Looks to Extensive Oil Development. J. E. Rassemuss. *World Petrol.*, 1947, **18** (8), 52–53.—In 1946 crude oil production in Peru amounted to 12,468,126 brl; of this 80·38% was produced by International, 17·92% by Lobitos Oilfields, and 0·98% by government exploitation. In addition natural gasoline production amounted to 1,041,407 brl, of which International and Lobitos produced 90% and 10% respectively. It is estimated that Peru contains larger reserves than other South American countries. The Montaña (basin of the Amazon river) covers 63 million ha. Of this International has been granted a concession of 166,546 ha. and Lobitos 56,544 ha. International has applied for a further 2,240,000 ha. Construction of a pipeline from the Montaña to the Pacific coast has to be considered for economic reasons, as the only transport at present is by river. F. S. A.

1459. Production in Venezuela Shows 20% Gain. Anon. *Oil Gas J.*, 15.3.47, **45** (45), 58.—Preliminary figures indicate that Venezuela produced 388,000,000 brl of oil in 1946. 562 oil wells, 7 gas wells, and 82 dry holes were drilled in 1946, and the average daily output rose from 979,094 brl in January to 1,120,051 brl in November.
G. D. H.

1460. Venezuela Reserves Gain 500,000,000 Brl. Anon. *Oil Gas J.*, 19.4.47, **45** (50), 68.—During 1946 Venezuela produced 388,491,000 brl of oil, and during that year the reserves were raised by 901,304,000 to 1,337,707,000 brl, to give a total reserve of 7,547,600,000 to 7,987,900,000 brl.

At the end of 1946, 11,589,793 acres were in exploration and development concessions, and 13,994,764 acres in development grants. G. D. H.

1461. Decline Predicted for Austrian Production. Anon. *Oil Gas J.*, 17.5.47, **46** (2), 61.—During 1946 Austria produced 846,000 tons of oil; the 1945 figure was 454,000 tons. Due to the removal of equipment it is expected that output will fall this year.
G. D. H.

1462. Hungary's 1946 Production 5,145,342 brl: Down 1·3 Million From 1943 High. Anon. *Oil Gas J.*, 24.5.47, **46** (3), 66.—Hungary's production attained a peak of 6,426,074 brl in 1943, but declined later in spite of the development of the Hahot field.

After Hungary declared war, a concession in the southern part of the Great Hungarian plain was granted to a German concern which carried out geophysical surveys. A wildcat at Totkomlos, 110 miles southeast of Budapesth, blew out from the Pliocene at 5092–5312 ft, flowing 20,000,000 cu. ft. of gas/day. The gas had 51% of CO_2 and 48% of hydrocarbons. A second well gave some gas, much salt water, and a little oil from fractures in a hard shale. A well at Korosszegapati, 125 miles east-southeast of Budapesth, gives 1,750,000 cu. ft. of wet gas/day from the Pliocene at 2500 ft. This gas has 60% of CO_2 and 40% of hydrocarbons.

By the end of 1943, 119 wells had been drilled at Lispe and 60 at Lovaszi, and the Lovaszi output reached 3,838,363 brl. The Ujfalu field was opened at the Yugoslav border on a small dome on the Peklenicza–Budafapuszta anticline. Oil was found in the Pliocene and gas in the Miocene. Hahot lies 10 miles northeast of Lispe. This structure is a buried Triassic limestone ridge covered by Miocene and Pliocene. Oil is produced from the contact zone between the Pliocene and Triassic, probably from porous limestones. Similar subsurface conditions were found in a well at

Salomvar to the northwest, and there were good oil shows. The return of part of Transylvania to Hungary led to search for gas. Nyaradsereda No. 2 gave about 5,000,000 cu. ft. of gas/day from the Sarmatian at 550–633 ft and 729–755 ft. Rava No. 1 (Near Edoszentgyorgy) had an initial output of 6,500,000 cu. ft./day from 607 ft. Both wells are on anticlines.

Traces of oil were found in a 5015 ft test at Izaszacaal abandoned in the Cretaceous. In 1943 drilling activity ceased at Peklenicza and Szelnicze, and the outputs fell to 20 brl/day and 18 brl/day, respectively.

Wildcats at Petesháza, southwest of Lovaszi, found oil at two horizons between 5472 and 5600 ft, and gave a small output. Six wildcats were drilled near Alsolendva, west of Lovaszi, and these gave some oil and gas from the same horizons as at Lovaszi.

G. D. H.

1463. Natural-Gas Development Under Way in Poland. Anon. *Oil Gas J.*, 17.5.47, **46** (2), 60.—During 1946, 117,085,000 cu. m. of gas were produced in Poland at Sadkowa–Roztoki and Strachocina. Daszawa, now within the Russian area, gave 83,097,000 cu. m.

A well completed at Debowiec, southwest of Oswiecim, late in 1946, had an initial output of 97 cu. m. from a depth of 397 m.

In 1945 Poland's oil output was about 2500 brl/day compared with 24,000 brl/day pre-war.

G. D. H.

1464. Continued Drop is Seen in Roumanian Production. Anon. *Oil Gas J.*, 22.2.47, **45** (42), 105.—The Roumanian oil output in 1946 was less than 31,000,000 brl, a decline of 25,700,000 brl from the peak of 1938. A further drop is expected.

G. D. H.

1465. Joint Russian Company Dominates Post-war Roumanian Operations. W. W. Burns. *Oil Gas J.*, 5.4.47, **45** (48), 44.—Hungarian oil production began in 1937 and in 1943 attained a peak of 17,600 brl/day. Current production is about 13,000 brl/day. The production rate has been substantially above the maximum efficient level.

The Soviet–Roumanian Oil Co. in 1940 produced about 24,000 brl/day. Natural gas production averaged 18,700,000,000 cu. ft. in 1943–45. During the war, development of gas fields in Transylvania continued, new fields being opened at Roua, Zau, and Cetatea De Balta to give a total of nine. Roumania's oil production in 1946 averaged 86,000 brl/day; it was 114,000 brl/day in 1941. Basically the decline results from lack of new discoveries. A further decline in output may ensue if more drilling equipment is not obtained. The probable reserves have been estimated at about 700,000,000 brl.

In Italy numerous shallow wells (900–1280 ft deep) have been drilled for natural gas mainly in the eastern Po plains and at Podelta. The A.G.I.P. developed the Podenzano gas field near Piacenza and this is now nearly exhausted. To the east the San Girogio–Podenzano field was discovered. Wet gas has been found on the Lodi structure at 4480 ft. The S.P.I. found two new gas fields in Ferrara province by gravity surveys. Bando was abandoned in 1946 because of poor development of the Quaternary producing sands. Malalbergo is still active. Small pockets of light oil have been found in developing the Pietramala gas field where the structure is complex.

A.G.I.P. drilled three dry holes in the Tertiary Bradanic trough north of Taranto. Wildcatting in Sicily has been unsuccessful.

In 1946 Brazil produced 61,466 brl of oil from Cretaceous or Jurassic beds. In 1946 some wells drilled at Candeias had initial outputs exceeding 1000 brl/day. The current Brazilian production is said to be about 5000 brl/day.

Geological and geophysical work has been carried out near the mouth of the Amazon, in the Parana basin, and in Sao Paulo. The Aragua–Lima wildcat has been deepened to the granite basement at 4918 ft.

In Sergipe a well drilled for salt encountered oil and gas shows in the Cretaceous.

G. D. H.

1466. Anglo-Iranian Output Shows Gain in September. Anon. *Oil Gas J.*, 4.1.47, **45** (35), 28.—Iran oil production in September 1946 was 11,004,000 brl, giving 100,072,000 brl for the period January–September.

G. D. H.

1467. November Anglo-Iranian Production Increases. Anon. *Oil Gas J.*, 15.3.47, **45** (45), 61.—In November Iran produced 12,498,600 brl of oil, giving a total of 129,537,000 brl for the first 11 months of 1946. G. D. H.

1468. Iranian Output Averages 394,500 brl Daily in 1946. Anon. *Oil Gas J.*, 24.5.47, **46** (3), 65.—Iranian oil output in 1946 was 19,200,000 tons, compared with 16,839,490 tons in 1945. G. D. H.

1469. Iranian Production Down. Anon. *Oil Gas J.*, 14.6.47, **46** (6), 74.—Iran produced 1,378,000 tons of oil in February and 1,640,000 tons in January 1947. G. D. H.

1470. Foreign Oil Production Reviewed in Sixteen A.I.M.E. Papers. W. W. Burns. *Oil Gas J.*, 29.3.47, **45** (47), 66.—The Agha Jari proved area is 12 miles long and 3 miles wide. White Oil Springs is to be developed further to augment the Haft Kel output. The Lali structure, 25 miles northeast of Masjid-i-Sulaiman, seems to have commercial possibilities.

The Dammam field yielded 94,753 brl/day in 1946, and Abqaiq gave 67,900 brl/day. Edgewater in the latter area has not yet been found; the oil column exceeds 1500 ft.

Extensive geological and geophysical work was carried out in Iraq in 1946. At the end of the year there were 17 producing wells. 6 wells were drilled in Bahrein in 1946.

The Sudr well found oil in the basal Miocene of the Gulf of Suez in 1946. Ras Gharib's average daily output was 23,055 brl, and Hurghada's 879 brl. Ras Gharib has 81 active producers and 14 producers shut in.

It is certain that after rehabilitation Burma's main fields will have considerably smaller outputs than before the war. During the early part of the war the Punjab output reached 2465 brl/day, but declined later. Geophysical work and drilling have been re-started.

India's oil output in 1946 was 6000 brl/day, compared with about 7100 brl/day in 1945. G. D. H.

1471. Chinese Hold Meagre Production Despite Patchwork Equipment. H. Forman. *Oil Gas J.*, 10.5.47, **46** (1), 48.—The Yenchang field of Shensi province was discovered in 1906. There was little activity for many years, but recently work has been going on with makeshift equipment, some of which is described. Production rose continuously from 1938, and in 1943 amounted to 4708 brl.

Oil is also produced in Kansu province to the west. By 1944 18 wells had been drilled in this area. Transport has hindered development. G. D. H.

Transport and Storage.

1472. Cathodic Protection of Steel Tank Bottoms by the Use of Magnesium Anodes. J. R. James and R. L. Featherly. *Petrol. Tech.*, May 1947, **10** (3), *A.I.M.M.E. Tech. Pub. No.* 2202, 1–7.—Replacement or repair of storage-tank bottoms damaged by external corrosion represents an expensive maintenance item. Cathodic protection as a means of reducing this trouble has been very successful in recent years. The cathodic protection of a 55,000 brl and two 20,000-brl tanks is described.

In the case of a 20,000-brl tank twelve 60-lb anodes were placed about 2½ ft from the periphery at approximately 17½ ft centres. Tests have shown that sufficient protection is afforded if the tank-to-soil potential, using a copper–copper sulphate half-cell as a reference electrode, is — 0·9 volt at the edge of the tank.

Potential measurements made a few months after installing the electrodes showed that the potentials were higher than needed for protection. Resistors were then inserted in the individual anode circuits. These increased the life of the anode installation and still provided adequate protection for the tank, giving yet greater tank protection and an even longer anode life.

The installation cost less than $300 for the 20,000-brl tank and the life of the installation was estimated to be 15 years. G. D. H.

1473. Cell-Type Underground Storage for Gas. Anon. *Oil Wkly*, 2.6.47, **126** (1), 33.—The use of molybdenum steel cells for the storage of gas is briefly described. The cells are buried in the ground below the frost line in order to secure more uniform temperature conditions. R. B. S.

1474. Centrifugal Compressors for Gas Trunk Pipelines. M. C. Shaw and E. T. Neubauer. *Oil Wkly*, 26.5.47, **125** (13), 37.—See Abstract No. 1060 (1947).

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

1475. Plastic Insulation. Provides Protection Against Stray-Current Corrosion in Wells and Piping Systems.—Oil and Gas Wells. J. A. Clay, Jr. *Oil Gas J.*, 26.7.47, **46** (12), 245.—Instances of corrosion of oilwell and other structures due to "stray-currents" of various origins are described. Protection from such corrosion is obtainable by the use of laminated plastic insulating materials in the form of: (*a*) pipe nipples; (*b*) ring or gasket-type insulators for use with steel flanges. The flanges, holding the gasket or ring insulator, are coupled together with steel bolts insulated with plastic sleeves, and a plastic washer in addition to the steel washer. Plastic pipe nipples are manufactured for two working pressures, viz. 500 and 1000 p.s.i. Their physical properties are given in a table showing: external and internal diameters, wall thicknesses, threads/in., and tensile strengths, for sizes 2, 2½, 3, and 4 in. Any length can be obtained, the standard lengths being 4 and 6 in. For operating pressures over 1000 p.s.i., or where equipment is of large size, insulated flanges must be used. A table shows the material list, per flange union. This gives the items of "make-up," number required, and description and measurements of the plastic materials; *i.e.*, plastic bolt sleeves, plastic washers, flange gasket (flat, or ring). Examples for ordering and some approximate prices are given. Plastic materials should be handled in a manner similar to copper or brass fittings. Extreme tightness in a joint is not necessary to effect a pressure seal, and if a joint is made too tight the material may be ruptured or so damaged that a failure may result. Recommendations are given for the installing of plastic materials on field and refinery jobs, and the precautions to be taken in insulated pipeline laying are discussed. W. H. C.

1476. Constructional Materials and Corrosion in Petroleum Refineries. H. Van Der Hoeven. *Ingenieur*, 25.7.47, (30) M23–25.—Due to the high losses experienced through corrosion the use of steels containing varying amounts of Chromium, Molybdenum, Silicon, and Niobium, is recommended, *e.g.*, 28% Cr steel for centrifugal pumps, 5% Cr steel for temperatures between 360–430° C, 25% Cr 20% Ni steel for asphalt stills and cracking, 0·5% Mo steel for temperatures above 600° C, 1·0% Nb steel for carbide formation and the non-separation of carbon in cracking coils. D. H. J.

1477. Volume of Liquid at High Temperatures. W. L. Nelson. *Oil Gas J.*, 12.7.47, **46** (10), 105.—No. 152 in the *Refiners' Notebook* Series gives a chart showing factors derived from temperatures (° F) and A.P.I. specific gravity at 60° F, by which the volume at 60° F should be multiplied to obtain volume at the high temperature. G. A. C.

1478. Modern Lubricating Oil Manufacture. E. R. Sinoley and D. Fulton. *World Petrol.*, 1947, **18** (Ann. Refinery issue), 62–68.—The world position for lubricating oil manufacture is reviewed and a brief description and flow diagrams are given of the main refining processes. The plant capacity of the major companies is listed. F. S. A.

Solvent Extraction and Dewaxing.

1479. Quality of Lubricating Oils Improved by New Furfural Plant in Kansas Refinery. L. C. Brown and C. F. Tears. *Oil Gas J.*, 12.7.47, **46** (10), 58.—The new Furfural refining unit at the Coffeyville, Kans., plant of the Co-operative Refining Association for solvent extraction of lubricating oils is described.

The unit will process 2200 brl/day of dewaxed neutral or 1050 brl dewaxed acid-treated bright stock in four separate operations: treating, solvent recovery from raffinate mix, solvent recovery from extract mix, and removal of water from solvent.

The treating tower operates under a pressure of 75 p.s.i.g. (surge tanks with attendant controls and pumps have been eliminated), and this pressure is automatically controlled. New controls have been devised for regulation of temperature gradient through the treating tower.

The raffinate recovery system omits the usual dry solvent flash section, the total raffinate mix being charged directly to the raffinate stripper. Dry solvent from the extract mix is recovered in an atmospheric exchange heated flash tower.

Liquid-level alarms are provided, motor- and turbine-driven centrifugal pumps are used where possible, and care has been taken to reduce loss of solvent to a minimum.

The new unit utilizes a slip stream containing 93% water from the " B " fractionator charge pump for reflux to recovery system towers instead of dry furfural. Daily loss of solvent averages 42 gal.

Treating conditions and laboratory analysis are given in two tables, and a flow-sheet is shown. G. A. C.

Cracking.

1480. An Investigation into the Kinetics of the Disproportionation of Hydrogen in Gasolines as Depending on the Composition of Aluminium Silicate Catalysts. K. V. Topchieva and G. M. Panchenkov. *Compt. Rend.* (*Doklady*) *Acad. Sci. URSS*, 1947, **55**, 505.—The effect of catalyst composition and method of preparation on its activity with respect to hydrogen disproportionation in a thermally cracked gasoline of boiling range 100–150° C was studied with a group of six catalysts varying in composition from 100% SiO_2 to 100% Al_2O_3. Catalyst activities were evaluated from the iodine values of the products, from which rate constants were evaluated for each temperature and feed space velocity (F.S.V.). The 100% SiO_2 catalyst was inactive; the results for the other five were expressed as graphs of (*a*) product iodine value *v.* F.S.V., (*b*) log. rate constant *v.* reciprocal temperature, (*c*) rate constant *v.* catalyst composition. From (*a*) it was found that the behaviour of the 100% Al_2O_3 catalyst was anomalous, the product iodine value remaining constant over a wide range of F.S.V. From (*b*) the activation energy of the reaction was found to be 4·3 k. cal/mol independent of catalyst composition, except in the case of 100% Al_2O_3 which gave a value of *ca.* 7. From (*c*) the most active catalyst had the composition 30% Al_2O_3, 70% SiO_2 corresponding to $Al_2O_3.4SiO_2$ which is close to the composition of a mineral of the montmorillonite type, to which the catalytic activity was ascribed. An explanation was also advanced for the similar manner in which catalyst activity varied with composition on both sides of the optimum value. G. H. B.

1481. Design and Operation of Leonard TCC Unit. G. Kelso, C. C. Peavy, G. D. Myers, and A. W. Hoge. *World Petrol.*, 1947, **18** (8), 48–51.—The paper is abridged from one read recently before the Western Petroleum Refiners Assoc'n. The plant, which commenced operation in March this year, was designed to process 4500 brl/day of reduced Michigan crude to give a reactor charge of 3000 brl/day. Catalytic equipment has been oversized to permit a reactor charge of 6500 brl/day. Catalyst circulation is maintained by a bucket-type elevator capable of removing 75 tons/hr of spent catalyst to the kiln and feeding to the reactor at the same rate. Operating data and a flow diagram of the catalytic section are given. F. S. A.

Polymerization.

1482. Converted Isomerization Unit Now Makes Polymer Gasoline. L. C. Brown. *World Petrol.*, 1947, **18** (6), 42–44.—See Abstract No. 1189 (1947).

Special Processes.

1483. Organic Chemicals from Petroleum. Anon. *World Petrol.*, 1947, **18** (8), 40–45.—The major part of the paper describes the development and present organization of Shell Chemical Corp. This is preceded by a general review of the U.S. petroleum-

derived organic chemical industry. Graphs indicating the increase in production of major compounds from 1933 are given, and the economics of the industry are briefly reviewed. The war did not greatly influence production except in the cases of toluene and butadiene where this was increased. During 1945 industry used 3·3 million lb of petroleum derived organic chemicals. F. S. A.

1484. The Manufacture of Synthetic Gasoline. G. Roberts and J. A. Phinney. *World Petrol.*, 1947, **18** (7), 46–49.—This is an abridgement of a paper recently read before the American Society of Mechanical Engineers. An outline of the Synthol process, for the production of gasoline from natural gas, is given. Development in the U.S. started in 1938 and the process is approaching the commercial stage. A simplified flow diagram is presented together with a description of some of the engineering problems involved. F. S. A.

PRODUCTS.

Chemistry and Physics.

1485. Hydrocarbons of *cyclo*Hexylindane Series. E. S. Pokrovskaya and T. G. Stepantzeva. *Compt. Rend.* (*Doklady*) *Acad. Sci URSS*, 1947, **55**, 829–831 (in English).—Previous to the present work, no hydrocarbons of the indane series with naphthene groups substituted in the aromatic ring had been described. Mono-, di-, and tri-*cyclo*hexylindanes of this type have been synthesized by the alkylation of indane with *cyclo*hexene using aluminium chloride catalyst. Viscosity data for the mono- and di-*cyclo*hexyl derivatives over the range 20–100° C are given, and their densities and refractive indices compared with those of mono- and di-*cyclo*pentyltetralins, in which the positions of the *cyclo*hexyl and *cyclo*pentyl rings are reversed. G. H. B.

1486. Method for Measuring the Heat of Wetting of Decolorising Charcoals. M. Pesez and R. Berret. *Chim. et Ind.*, 1947, **58**, 28–30.—A calorimeter is described in which the heat of wetting of activated charcoals, when dispersed in benzene, can be measured. The instrument is calibrated by means of a known amount of heat developed electrically, the results being plotted graphically. The exact amount of heat developed when a pellet of charcoal is substituted for the electric heating element can thus be calculated. Results on seven grades of activated charcoals, having heats of wetting ranging from 8–17·1 g. cal./g., show that this method rates the adsorbents in the same order as the methylene-blue test. V. B.

1487. Measurements of Ethylene Viscosity at Pressures up to 1000 Atm by the Oscillating Disc Method. M. G. Gonikberg and L. F. Vereshchagin. *Compt. Rend.* (*Doklady*) *Acad. Sci. URSS*, 1947, **55**, 801–804 (in English).—Previous work on the viscosities of gases at high pressures is briefly reviewed and the present apparatus, intended for pressures up to 3000 atm, described. Data for ethylene at 24° C over the pressure range 100–1000 atm are tabulated. G. H. B.

Analysis and Testing.

1488. Analyses of Alkylates and Hydrocodimers. A. R. Glasgow, Jr., A. J. Streiff, C. B. Willingham, and F. D. Rossini. *Bur. Stand. J. Res., Wash.*, May 1947, **38** (5), 537–581.—Results are presented for the analyses, with respect to individual hydrocarbon components, of twenty-eight alkylates and hydrocodimers, including fifteen sulphuric-acid alkylates (one C_3, six C_4, one C_4–C_5, four C_5, one hot-acid dimer, one hot-acid trimer, and one cold-acid trimer), five hydrofluoric-acid alkylates (one C_3, one C_3–C_4, one C_4, one C_4–C_5, and one C_5), and eight hydrocodimers.

The analytical procedure is described for one sample, a C_4 alkylate. Extended distillations were performed at high efficiency, with high reflux ratio, and using accurately measured values of boiling point (to $\pm$ 0·01° C), obtained during the distillations, and refractive index (to $\pm$ 0·0001), obtained on fractions after distillation. Results are shown graphically.

A C_4 alkylate was also analyzed spectrographically by six laboratories, and results are given for one Raman, one mass, and four infra-red spectrometers.

A list of five references is appended. W. M. H.

1489. Analysis of Benzol Forerunnings. E. Saito. *Rev. Inst. Franç. Pétrole*, 1947, **2**, 227–234.—A detailed analysis was made of the forerunnings of a coal-tar benzol. The raw material was derived from a crude benzol which had been obtained by the stripping of absorber oil and had then been refined in the usual way with sulphuric acid followed by caustic soda. The forerunnings amounted to 6% of the crude benzol and had d_4^{15} 0·869, n_D^{14} 1·4942. Two batches were fractionated, the first into twenty-six cuts boiling between 23 and 76° C and the second into thirteen cuts in the range 30–75° C. The second batch had, previous to fractionation, been treated with potassium hydroxide and amyl alcohol to remove carbon disulphide and with sodium bisulphite to remove acetone and acetaldehyde. The fractions were subjected to examination by physical (Raman spectra, density, refractive index, specific dispersion, critical solution temperature) and chemical (bromine number, sulphuric acid treatment) methods. In addition to compounds previously reported as being present in material of this type the following were identified: *n*-butane (2%); butene-2 (2%); acetaldehyde (Trace); pentene-2, *trans* and *cis*; *cyclo*pentene; pentyne-2 (total pentenes 20%); *cyclo*pentane (total pentanes 23%); *iso*hexane (total hexanes 24%); *cyclo*hexane; methyl*cyclo*pentane (total *cyclo*hexane and methyl*cyclo*pentane 6%). The proportions are calculated on the total of non-benzene compounds boiling lower than benzene. Of all the analytical methods mentioned, most attention is devoted to the Raman spectra, the experimental results being quoted in some detail.

V. B.

1490. Determination of Iron Pentacarbonyl in Gasoline. Anon. *Chim. e Industria*, 1947, **29** (2), 35–36.—Existing methods for the determination of iron pentacarbonyl are reviewed. A new method, depending on the decomposition of iron pentacarbonyl to ferric oxide in ultra-violet light, is proposed for the conversion of the carbonyl group and this is applied to the photometric determination of iron. D. H. McL.

1491. Stage Estimation in Lubricating Distillate Extraction. V. G. Skogan and M. C. Rogers. *Oil Gas J.*, 2.8.47, **46** (13), 70, 73–75.—Methods have been presented by several workers for the estimation of the number of equilibrium stages needed to complete a liquid–liquid counter-current extraction with a given solvent. The authors describe investigations using two solvents, chlorex and furfural, and a wax-free distillate from a Winkler County, Texas, crude with a viscosity index of 42·5 and A.P.I. gravity 18·6°. Extractions were single and multi-stage, using different solvent–oil ratios, and details of apparatus and method of extraction are given.

The Hunter and Nash method, using triangular diagram and equilibrium data for single-stage extractions, is discussed and shown to be inapplicable without making empirical adjustments. The authors suggest a means whereby the method may be used for problems of design, providing single-stage data for a wide range of solvent–oil ratios are known, and multi-stage data for at least one oil–solvent ratio on any given oil and solvent and number of stages, are determined. W. M. H.

1492. Co-operative Analysis of a Standard Sample of Natural Gas with the Mass Spectrometer. M. Shepherd. *Bur. Stand. J. Res., Wash.*, May 1947, **38** (5), 491–498.—The analysis of the third sample of natural gas in the A.S.T.M. series of co-operative analyses was carried out using the mass spectrometer. Preparation of standard sample was as described in *Bur. Stand. J. Res.*, 1947, **38**, 19, and procedures for operating, calibrating, and computing were as prescribed by the manufacturers of the instruments. Results showed the apparatus to be capable of reproducibility, and, to some extent, accuracy.

Analytical data are presented as frequency–distribution plots. Heating values and specific gravities have been calculated from the results, and compared with the known values. W. M. H.

1493. The "Octabenzene," *cyclo*-Octatetraene. O. Bastiansen, O. Hassel, and A. Langseth. *Nature*, 1947, **160** (4056), 128.—Electron diffraction analysis of *cyclo*-octatetraene (C_8H_8) vapour indicates that all the C bonds are equivalent and the

C–C–C angles are 120°, leading to the conclusion that the molecule exists as a puckered ring with equivalent bonds. The nature of the bonding forces is such that the molecule would be more unsaturated than benzene, and this is in accord with experiments.

The Raman spectrum below 2000 cm^{-1} has been investigated, and the lines are listed together with their intensities. H. C. E.

1494. Application of Radiography by Means of Secondary Electrons. The Study of Thin Organic and Inorganic Layers. J. J. Trillat and C. Legrand. *Rev. Inst. Franç. Pétrole*, 1947, **2**, 250–251.—Use of radiography by secondary electrons, for the detection of thin layers of lubricants on metals, is described. A sheet of polished steel, on which is deposited a thin layer of lubricant, serves as the emitter of secondary electrons. A fine-grained photographic film is laid on the steel, the sensitized side being against the lubricant layer. Excitation is by means of X-rays from a 180 Kv tube, filtered through 3 mm of copper. The thickness of the lubricating layer at any point can be determined from the photographs obtained, by measuring photometrically the darkening of the film. The method, which is also applicable to films of inorganic materials, can be used for film thicknesses ranging from 1 to about 50 microns. V. B.

1495. Study of Methods for the Selective Coloration of Calcite on Polished Surfaces. P. Canal. *Rev. Inst. Franç. Pétrole*, 1947, **2**, 235–243.—A detailed petrographic study of dolomites from the Aquitaine basin was undertaken, involving an examination of the methods available for differentiating calcite from dolomite. Selective coloration is favoured, the published methods are critically reviewed and that first described by Lemberg, over 50 years ago, is recommended. The procedure followed is to immerse the sample, the polished face downwards, for 3 min in N silver nitrate at 65° C, water washing and then immersing for ½ min in 10% potassium chromate, washing and allowing to dry. The colour film thus obtained is highly stable; on viewing by transmitted light, calcite is reddish whilst dolomite remains colourless. The limits of the method and precautions to be observed are described. An X-ray study of the coloured films obtained with various reagents gives a theoretical basis for the validity of the method selected and explains the tenacity of the film. V. B.

Gas.

1496. Liquid Gas and Coal. A. E. Coburn. *Fuel Oil and Oil Heat*, May 1947, **6** (1), 57.—Synthetic oil was first obtained from coal by the Bergius process, in which hydrogen is forced at 3000 lb pressure through a paste of pulverized coal at 850° F. This has given way to the Fischer–Tropsch process, in which gas (either natural or manufactured) when heated to about 650° F at 250 lb pressure in the presence of a catalyst, liquefies to oil. Oil from natural gas is produced by a modified Fischer–Tropsch process, the gas being converted to liquids of varying molecular weights, ranging from gasoline to wax.

Natural gas, which is the cheapest to use, is rich in both hydrogen and carbon. The principal manufactured gas is water gas (carbon monoxide and hydrogen), but by using higher pressures in the manufacture, some of the carbon combines with the hydrogen to form methane. This gas has a higher calorific value than either hydrogen or carbon monoxide.

The cost of natural gas is only about one-third as much as the equivalent amount of coal; when the latter is used for oil-making it need not be clean, so the chief element in cost is its bulk handling. One major development now being studied with regard to saving this cost is the collection of the gas by setting fire to underground coal seams.

It is cheaper to use gasified coal as fuel, rather than as raw material for the manufacture of oil, so synthetic oil is more likely to be made from natural gas at present. C. D. B.

Engine Fuels.

1497. New Method of Interpreting Analyses of Internal Combustion Engine Exhaust Gases. M. Serruys. *Compt. Rend.*, 1947, **225**, 104–106.—The approximations and assumptions involved in the methods hitherto used to calculate mixture strength from exhaust gas analyses are critically discussed and an alternative procedure described, based only on the assumption that the exhaust gases do not contain solid carbon.

The richness of the mixture is for this purpose redefined as: the ratio of combined carbon in the exhaust gases to the nitrogen derived from the air involved in the combustion, as compared with the total quantity of carbon which would have been associated with the same amount of nitrogen derived from the air required for theoretical complete combustion. This definition is used to derive an equation from which the mixture richness can be calculated from exhaust gas analyses for carbon dioxide, carbon monoxide, methane, hydrocarbons, and nitrogen. The precision obtained is high because the most important terms in the equations involve the major constituents of the exhaust gases which can be determined with the least error. The calculation requires a knowledge of the elementary composition of the fuel, but provided that it does not contain combined nitrogen, the value of the coefficient derived from its composition can also be estimated from exhaust gas analyses on weak mixtures, by making certain simplifying assumptions regarding the products of combustion under these conditions. G. H. B.

1498. More Efficient Utilisation of Fuels Provided by New High-Compression Automobile Engines. C. F. Kettering. *Oil Gas J.*, 12.7.47, **46** (10), 73.—An abridged version of a paper presented at Society of Automotive Engineers in French Lick, Ind., in June 1947, is given.

The discovery of the relation of molecular structure of hydrocarbons to the knocking characteristics of a fuel led to the development of high-octane fuels. Triptane, with tetraethyl lead added, may have a performance number of 500 under some engine conditions, compared with 100 for octane. The practical compression range was studied on a special 30 cu. in. single-cylinder engine on a range of compression ratios from 6 to 1 up to 15 to 1. Figures show improvement in efficiency with increased compression ratio; also compression and firing pressures of the single-cylinder high-compression engine.

A 1946 production car was chosen on the basis of the single-cylinder engine tests, and studies of engine performance made. A comparison of full-throttle corrected power, brake mean effective pressure, and volumetric efficiency for the high compression and 1946 stock engine is given on figures. Road tests were made, and data shows that the high-compression car gives from 35 to 40% better fuel economy than the standard car.

Three widely different fuels were tested in the 6-cylinder engine with 12·5 compression ratio, and it is shown that with 99/87 O.N. gasoline the engine can be satisfactorily operated. A diagram indicates flexibility in balancing engine design with available fuels, concerning the conception of "mechanical" O.N. in addition to the conventional "chemical" octane figure. G. A. C.

1499. Carbon–Hydrogen Ratios of Distillate Fuel Oils. S. P. Cauley and E. B. Delgass. *Oil Gas J.*, 19.7.47, **46** (11), 83.—In an earlier paper (Abstract No. 1132/1946), the authors gave a correlation of carbon–hydrogen ratios of pure hydrocarbons with their properties of A.P.I. gravity, aniline point, and boiling point, and discussed its application to the study of catalytically cracked distillate fuel oils. As the correlation, however, was not sufficiently accurate for such distillate fuels, further work was carried out on twenty-two fuel oils, representative of refinery production of distillate fuels, having distillation slopes (using 10 and 90% points) ranging from 0·2 to 4·56, and 50% points ranging from 430° to 671° F. The results are shown in a table, and graphs have been constructed and are reproduced. These show: (*a*) that the "A" factor used in the pure hydrocarbon C/H ratio correlation [A = diesel index—(0·05 × A.S.T.M. 50% point)] when plotted against actual C/H ratios gave good correlation; (*b*) that the comparison of calculated and experimental C/H ratios, showed an average deviation of 0·67%, and a probable error of 0·58%. It is concluded that the experimental C/H ratios obtained by this substitution of A.S.T.M. 50% point for the boiling point of pure hydrocarbons, are sufficiently close to the true C/H ratios to justify the use of the correlation in comparative fuel studies. A nomogram for the purpose is given. W. H. C.

Gas and Fuel Oil.

1500. Diesel Fuel Situation. E. F. Miller and F. L. Nelson. *Oil Gas J.*, 21.6.47, **46** (7), 82–89.—The future demand and supply position for petroleum products (par-

ticularly diesel fuel) in the U.S.A. is discussed. It is estimated that the total consumption of petroleum products in 1960 will have increased by half a million brl (*i.e.*, 10%) over the 1945 figure, though the ratio of demands for the various products will probably remain more or less constant.

For diesel fuel, total consumption will be about 135,000 brl/day in 1948, compared with 65,000 brl in 1939, the increase being due to railroad applications, armed services, gas and electric companies, manufacturing, mines, trucks, and buses. Tables are given which show the typical properties, source and uses of diesel fuels to-day, those discussed being distillate fuels (*i.e.*, Fuel Oils Nos. 1, 2, and 3), and residual fuels (*i.e.*, Fuel Oils Nos. 5 and 6). As a general rule, catalytic processes produce higher quality fuel oil than thermal processes, and for greatest efficiency the heaviest fuel should be used, providing its other properties are not detrimental to engine operation. A high sulphur content in diesel fuels results in wear and engine deposits, particularly in medium- and high-speed engines. In the past, the use of sour crudes has been avoided, but shortage of low sulphur crudes and increased demands will necessitate greater use of high sulphur products. The result will be a future diesel fuel supply of lower cetane number and higher sulphur content, with an increase in the cost of distillate fuels. It is hoped that low cetane number fuels will not greatly increase maintenance difficulties, but high sulphur content is likely to lead to extra wear and deposits, and the cost of this must be balanced against the premium cost of low sulphur fuels. W. M. H.

1501. Railroad Dieselization Points to Important New Fuel Market. J. E. Boice. *Oil Gas J.*, 21.6.47, **46** (7), 66–68.—The Inter-State Commerce Commission's Bureau of Transport Economics and Statistics has recently published figures which emphasize the shift from coal to oil on American railroads. An analysis has been made to determine the effect of this changeover on the petroleum industry.

During the years 1935–45 the number of steam locomotives in the United States fell from 45,614 to 38,853, while diesel-electrics rose from 113 to 3816, and oil-burning locomotives from 6632 to 6921. In many places the trend in 1947 seems to be towards complete dieselization.

Factors responsible for the change are the need for modernization, labour troubles in the coal-mines, and general operating economy. Under this last heading are included lower per-mile cost of diesel-electrics, higher utilization, and high-speed hauling capacity. Their smooth motion cuts down track maintenance costs, they require less time for repairs than steam locomotives, and electrical equipment takes only a short time to replace. Their horse-power per unit of fuel is also greater than that of the old steam engines.

Since 1918 the tonnage of coal used by the railroads in the United States has steadily decreased, while fuel and diesel oils have shown a corresponding increase. In 1918, coal accounted for 93% of the total fuel used for locomotives, and fuel oil for the remaining 7%; in 1945, coal had dropped to 80%, while fuel oil had risen to 20%, and it is estimated that in 1947 the railroads will certainly use more diesel fuel than in any preceding year.

Four tables give details of types of engine, consumption, and costs. W. M. H.

Lubricants.

1502. Scoring and Burnishing in Bearings. V. H. Brise. *Aircr. Engng*, July 1947, **19** (221), 218.—A drawing is shown of a thrust-bearing machine which produces "boundary" lubrication conditions. The rotor (with four test-pieces) is rotated on a steel disc and results are quoted for speeds of about 600 r.p.m. for thrust pressures between 0 and 2000 lb/in. The whole is immersed in an oil-bath maintained at a controllable temperature. Results include the use of Aero DTD 472 B, S.A.E. motor oils, medicinal paraffin, and light anti-freeze oil. I. G. B.

1503. Reduction of Mechanical Friction in Rotating Bearings. P. Gerard. *Compt. Rend.*, 1947, **225**, 94–96.—A new type of bearing is described based on the formation of a region of pressure between the spindle and the bearing, which does not depend for its existence on relative movement of the two components. The pressure is applied from an independent source to a fluid contained in a system of interconnected chambers and grooves cut into the surface of the bearing; the viscosity and oiliness of the fluid

used are not important and its selection can be based on its other properties. When the bearing is rotating any force tending to move it from its equilibrium position in the symmetrical pressure field established by the fluid disturbs the symmetrical transfer of fluid from the chambers to the grooves in such a manner that a modified pressure distribution is developed which balances the force tending to displace the journal. The latter thus floats suspended in the fluid, and the energy dissipated in the latter is small, because of its low viscosity. Two practical applications of this bearing design are described: (*a*) a 30 mm diam. spindle in two such bearings supplied with water at 5 kg/cm^2 and operating at 18,000 r.p.m., (*b*) a bearing to support a spindle subjected to a constant force such as a weight load supplied with water at 2 kg/cm^2. The reduction in friction can be demonstrated electrically by the absence of metallic contact between the rotating and fixed members, and also by measuring the frictional torque of the undriven rotor oscillating about its equilibrium position. For a 50 kg rotor this is 3·45 cm-g, compared with about 20 cm-g for the same rotor in special ball bearings, and this residual friction in the new bearing is due only to mechanical imperfections. It is hoped to apply the principle of the new bearing design to the compensation of errors due to play in the assembly and elasticity of the constructional materials.

G. H. B.

1504. Modern Trends in Bearing Metals. Part III. P. T. Holligan. *Oil Engine and Gas Turbine*, July 1947, **15** (171), 82.—Indium plating of the bearing to inhibit corrosion by oil products is effective in the case of lead-plated copper–lead bearings, as well as with cadmium-base alloys. A coating of lead–tin alloy is equally resistant to oil corrosion.

The material used for the bearing metal is largely dependent upon crankshaft hardness. With copper–lead-lined bearings, graphitic cast iron crankshafts give a good performance.

The advantages claimed for the silver bearings are its high thermal conductivity, and the precision of production control which can be achieved. A lead–indium coating on the silver gives the best results; if this plating is removed, by wear or corrosion, the bearing properties of the silver thus exposed are not altogether satisfactory. Steel or bronze are used for bearing shell materials. If the latter is used, it should be gun-metal, which gives better results than phosphor–bronze. Steel is most generally used for big-end shells.

The thermal conductivity of the complete bearing assembly, as distinct from local heat-dissipation, is dependent upon such factors as intimacy of contact between shell and housing, and available radiating and conducting surface. When the crankcase is made of aluminium, there is a tendency for steel shells to lose interference fit owing to the higher expansion of the aluminium when the engine is heated up. This may be remedied by changing to bronze shells, but there may then be a permanent yield of the shell when tightening up in the cold owing to its lower elastic limit. C. D. B.

Derived Chemical Products.

1505. Interaction of Styrene with Magnesium Perchlorate and Other Salts. H. S. Lilley and G. L. Foster. *Nature*, 1947, **160** (4056), 131.—During an attempt to dry styrene with magnesium perchlorate a highly viscous polymer was formed after 3 weeks. It was subsequently found that after 48 hr magnesium perchlorate and styrene dried over sodium sulphate showed 13% polymerization; styrene saturated with water showed 6%. With magnesium chloride the effect was slower, but the "dry" olefin was converted to a viscous polymer in 2 months, whilst the "wet" olefin was unaffected. Anhydrous calcium sulphate also promoted polymerization after long periods.

It is therefore unsafe to use magnesium perchlorate for drying styrene, and probably other olefins, too. H. C. E.

Coal, Shale and Peat.

1506. Investigation on the Working of Certain Shale-Oils. V. Berti and G. Salvi. *Chim. e Industria*, 1947, **29** (3), 67–70.—A practical method is described for the evaluation of certain ichthyolic shale oils from the point of view of yield and of the quality of the ammonium salt of sulphonated ichthyol produced. The oils of S.

Romedir and Besano, already employed for the production of therapeutic substances similar to the original Cordes Ichthyol, are taken as examples. After reviewing the industrial methods for production of shale oil, the sulphonation of ichthyol and separation of ammonium sulphoichthyolate in the pure state is described. The sulphonation takes place with H_2SO_4,H_2O at 70–80° C on the fraction of oil distilling between 200–300° C. Extraction of the sulphonated oil is almost quantitative using a solvent comprising 90 parts benzene and 10 parts *iso*butyl alcohol. On neutralization of the extract with ammonia, the crude ammonium salt is obtained. Acidification and repetition of the extraction treatment followed by neutralization yields the pure substance, except that some ammonium sulphate remains. The analysis of the products is reported, together with figures on commercial products. Finally, the economic expediency is discussed of blending other oils with the ichthyols in order to produce combustible materials. D. H. McL.

Miscellaneous Products.

1507. Industrial Synthesis of Dichloro-Diphenyl-Trichloroethane (D.D.T.), and Ancillary Operations at the Chemical Defence Factory, Northrand. W. Bleloch. *J. chem. metall. min. Soc. S. Africa*, 1947, **47**, 353.—A complete account of the manufacture of D.D.T. at Northrand, South Africa, is given.

After a pilot plant had produced D.D.T., full-scale units to produce 600 tons/annum were constructed and put into operation in July 1945.

The raw materials for the synthesis are salt, alcohol, and benzene; the process being a complex electro-chemical one entailing electrolysis of sodium chloride to chlorine gas and caustic soda, which latter is sold as a by-product. Alcohol is chlorinated by the chlorine to give chloryl, and benzene to give mono-chlorbenzene, and these two products are reacted in the presence of sulphuric acid to give D.D.T.

The benzene is chlorinated in a reaction system equipped with scrubbers to recover maximum benzene vapour; benzene is stripped from the chlorinated product and the mono-product separated from the dichlorbenzenes by distillation; the catalyst used in the plant being ferric chloride.

After design difficulties had been successfully overcome, a unit for the chlorination of alcohol to produce chloral was erected. This comprises a chlorinator with absorption system and a chloral still.

The condensation of chloral and mono-chlorbenzene to give D.D.T. is complicated by the problem of removing water of reaction with strong sulphuric acid and the process is continually being improved. The product is batch produced, as are the two intermediates. Crude D.D.T. is formed in the condensation reactor by adding a fixed amount of sulphur trioxide to the fixed charge of intermediates. The mode of acid disposal is described, and the chemistry of the D.D.T. synthesis and its analytical control is discussed. The specification requirements of technical D.D.T. as produced in Britain are quoted. Operating efficiencies, plant capacities, and salient chemical engineering aspects of the industrial synthesis of D.D.T. and effluent disposal are fully given. G. A. C.

1508. Chemical Reactions of Fatty Oils. III. Drying, Gelatinization, and Rancification. A. Paleni. *Chim. e Industria*, 1947, **29** (4–5), 100–110.—The article discusses thermal gelling of drying oils, molecular distillation in the study of gelled fish and linseed oils and effect of oxygen on these oils. (According to Kappelmeier's theory, gelatinization depends on polymerization as a result of a Diels–Alder type reaction.) Positive and negative catalysts for the oxidation of oils and aldehydic and ketonic rancification are also discussed. It is suggested that thermal gelling of drying oils may be due to the activation of oxide and peroxide compounds and to their consequent isomerization to hydrocarboxylic groups, ketones, and, following on a rupture of the oxidized chains, to carboxylic acids. The activity of the latter in causing viscosity increase depends on the radicle to which the polar group is attached. D. H. McL.

Engines and Automotive Equipment.

1509. Development of the Goblin Engine. E. S. Moult. *J. R. aero. Soc.*, 1947, **51**, 655.—The author traces the history and stages in the development of the engine; in

particular the following components are described: Compressor (giving the test curves), descriptions of Rig and production of Impellors, Turbine, Combustion Chambers, Fuel System and Starting, and Testing. I. G. B.

1510. The Apollo. Anon. *Flight*, 21.8.47, **52**, 187.—This is an Armstrong-Whitworth turbine driven civil aircraft with a high safety factor. Power units are to be four Mamba II turbines driving reversible-pitch airscrews. I. G. B.

1511. The "Ghost" Lancastrian. Anon. *Aeroplane*, 22.8.47, **73** (1889), 217.—In addition to being tested in Vampires, "Ghost" turbines are now being fitted to Lancastrians for the purpose of fuel consumption and endurance tests on an aircraft which has space available for test instruments and automatic observer equipment. The "Ghost" is mounted in a similar way to that adopted for the Rolls-Royce Nene engines. Details are given of the turbine fuel system and of the structural installation. I. G. B.

1512. American Jet Experiments. Anon. *Aeroplane*, 8.8.47, **72** (1887), 162.—Power plant data are given for the Convair XP-81 and the Bell XP-3. The former has one G.E.C. axial flow gas turbine driving a four-bladed airscrew and one G.E.C. centrifugal compressor jet unit. Maximum power output 2300 b.h.p. at 13,100 r.p.m. at sea-level, and 4000 lb static thrust at 11,500 r.p.m. at sea-level. Maximum fuel capacity is 1193 Imp. gall.

The second aircraft is powered by two G.E.C. centrifugal compressor jet units; maximum power output for each engine is 4000 lb at 11,500 r.p.m. at sea-level. I. G. B.

1513. Photography in Engine Research. H. D. Goulding. *Aire. Prod.*, Aug. 1947, **9** (106), 283.—Photography in its various applications can be a very valuable instrument in research, but special studies of a specific problem in adaptation of the equipment are necessary in order to obtain successful results. In this and succeeding articles the author reviews a number of examples of work actually carried out in engine research showing how both still and ciné photography can be applied to the investigation of different phenomena. I. G. B.

1514. Loop-Scavenge Two-Stroke. H. D. Carter. *Gas Oil Pwr.*, 1947, **52** (502), 209.—The advantages of a loop-scavenge two-stroke engine, compared with an exhaust poppet valve two-stroke unit, are: (1) The mechanism is simpler; (2) Exhaust temperatures are much lower at all b.m.p., whilst fuel consumption is approximately the same. Recent criticisms concerning the relative performances of the two types of engine are answered. H. C. E.

1515. Polar Two-Stroke Vertical Engines. Anon. *Gas Oil Pwr.*, 1947, **42** (503), 249–251.—These engines have two to eight cylinders of dimensions 18 by 30 cm and operate at 600 r.p.m., giving a power range of 110 to 464 b.h.p. Scavenge air pressure at 2 p.s.i. is delivered by a centrifugal pump, and in order to maintain the engine temperature whilst the engine is idling a patented valve is inserted between the pump and the scavenging air receiver.

The engine can use low cetane fuel, for the injection commences at low pressure with a small amount of fuel, which later in the stroke blends into a normal main injection. Fuel consumption is 0·375 lb per b.h.p.hr. H. C. E.

1516. Low Cooling Water Temperatures [for I.C. Engines]. Anon. *Gas Oil Pwr.*, 1947, **52** (502), 206.—To obtain the best results from cooling water a number of factors must be considered. Inlet water at too low temperatures induces stresses in the jackets, which thereby tend to crack. The water surfaces must be free from scale, or the heat transfer to the water may be so small that insufficient cooling is obtained. Cooling water temperatures also affect fuel consumption; in a test the consumption fell from 0·469 to 0·430 lb per b.h.p.hr when the jacket temperature was increased from 77 to 185° F.

It is recommended that the quantity and temperature of the water supplied should be such that inlet and outlet temperatures are 110–120 and 140–150° F respectively. H. C. E.

1517. Causes of Smoky Exhaust. P. H. Schweitzer. *Oil Engine and Gas Turbine*, Aug. 1947, **15** (172), 139.—A normal engine burning normal fuel should only smoke at full load ("hot" smoke) or at very light load ("cold" smoke). Hot smoke can be remedied by lowering the compression ratio, and by improving the fuel/air mixture, which becomes over-rich in parts at full load. Cold smoke can be corrected by a higher compression ratio, and by advancing the injection timing, thus giving the fuel more time to burn and providing conditions favourable to turbulence.

The effect of the cetane number of the fuel varies according to whether the engine is running hot or cold, but in either case the cetane number is without effect in a range of values between 44·3 and 59·7.

The amount of fuel supplied to the engine is limited by the "smoke stop" on the jerk pump; if this stop is set correctly to prevent smoke at high speeds, the engine will fail to give its optimum torque at low speeds. To eliminate smoke without cutting down the power, therefore, the desideratum is a fuel injector pump which has declining delivery characteristics. C. D. B.

1518. The Graphical Study of Forced Oscillations in a Tube Coupled to Oscillating Systems. R. Kling. *Compt. Rend.*, 1947, **225**, 46–48.—The system considered is the fuel injection equipment of an internal combustion engine and the tube is that connecting the fuel pump and injector. This tube is most frequently of such a length that it is not possible to neglect pressure wave propagation phenomena in the system. The equation describing the pump delivery is not of a sinusoidal character, making a complete analytical solution of the problem impossible, but a graphical approximation method due to Bergeron has been successfully applied to determine, with the aid of a delivery v pressure graph, the behaviour of the fluid being pumped at various points along the tube. An expression is given for the volume delivered by the pump over a small time interval, which contains the coefficient of adiabatic compression of the fluid, the combined pump and pump-valve volumes, and the pressure–time characteristics of the pump as parameters. A differential equation describing the movement of the injector needle as a function of time is developed, involving the needle mass and displacement, the force exerted by its return spring, the coefficient of friction of the valve, etc. The two expressions are treated graphically to determine the pressure wave phenomena in the connecting tube and the valve return spring and other characteristics of the system. G. H. B.

1519. Diesel Engine Testing. Anon. *Gas Oil Pwr.*, 1947, **42** (503), 237–240.—In testing prototype and experimental engines studies of engine conditions and pressure variations in the fuel and exhaust systems are essential. With rotational speeds up to 350 r.p.m., cylinder pressure diagrams may be taken with a conventional indicator, but at higher speeds inertia of the moving parts causes distortion of the diagrams. The Farnborough Indicator used in such circumstances comprises a floating disc electrically insulated and screwed to the cylinder-head; pressure variations in the cylinder distort the disc, which makes and breaks electrical contacts and so registers differences on a revolving drum.

The Standard–Sunbury Indicator is a further refinement, and consists of a mechanism which converts mechanical movements into electrical potentials which are then amplified and supplied to a cathode-ray oscillograph. For pressure diagrams the pick-up unit is a steel diaphragm 0·03 in thick with a natural frequency of 40,000 cycles per second. Its deflection varies the air gap in a magnetic field and produces in the surrounding coil a varying potential which after amplification is supplied to the vertical plates of the cathode-ray oscillograph. The voltage is proportional to the velocity of the diaphragm's vibrations and the diagram therefore shows the rate of change of pressure in the apparatus being tested. The horizontal plates of the oscillograph are controlled through condenser and resistance by the engine, and enable as little of the engine cycle as desired to be spread over the whole width of the screen. Movement of the fuel injection valves can be similarly studied by placing a magnetic field round the injector needle, which then acts in the same way as the diaphragm described above. H. C. E.

1520. New Thornycroft Marine Diesels. Anon. *Gas Oil Pwr.*, 1947, **42** (503), 252–254.—Two new types of six-cylinder engine develop 50–65 and 90 b.h.p. The first has cylinders 3$\frac{1}{8}$ in bore by 4$\frac{1}{2}$ in stroke, with a compression ratio of 18·2 : 1, and the

second has cylinders 4½ in by 6 in with a compression ratio of 16 : 1. The ancillary equipment, comprising fuel pump unit, starting gear, lubrication and cooling systems, are described. Two photographs and a line diagram are given. H. C. E.

1521. New Ruston Engine. Anon. *Motor Ship*, Aug. 1947, **28**, 177.—Details are given of a new engine for coasters and trawlers with an output ranging from 1340 b.h.p. to 2410 b.h.p. The speed is 435 r.p.m. and the engine is built in a range having five to nine cylinders with a rated output of 268 b.h.p. per cylinder. Exhaust gas turbo pressure charging is employed and the b.m.e.p. is 119·2 p.s.i. at full load. It is stated that the fuel consumption of the engine is 0·37 lb per b.h.p.hr. I. G. B.

1522. Fuel-oil Burners for Locomotives. Anon. *Energie*, May 1947, **31** (34), 139.—A description of a typical oil burner used by locomotives on French railways. (Translated from *Railway Gazette*, 15.11.46, **85**, 553–556.) G. P. K.

1523. General Survey of Gas Turbine Problems. M. Serruys. *Energie*, May 1947, **31** (34), 134.—Part II of a study of the thermodynamic theory of gas turbines. G. P. K.

1524. New Cylinder Liner. Anon. *Gas Oil Pwr.*, 1947, **42** (503), 248.—Chromium plating 5–6 thousandth in. thick is laid on a solid-drawn "40 carbon" steel liner, and the deposit is "lattice etched" to give uniform mottling with depressions ¼-in diameter and ¼-in apart, thus producing a good oil-retaining surface of great hardness. Piston friction is said to be reduced and cylinder wear is about one-eighth of normal; when wear does occur the liner can be re-plated and re-etched. H. C. E.

1525. Protective Treatment of Ferrous Springs. Anon. *Oil Engine and Gas Turbine*, Aug. 1947, **15** (172), 109.—Springs needed for heavy duties can be protected against corrosion during storage by means of superficial coatings, such as paint or enamel. These coatings, however, are ineffective during the operation of the spring, as they then become porous.

Protection against corrosive fatigue in service is given by electro-plating the surface of the spring with metals such as zinc, cadmium, etc., or by diffusion processes, in which the coating element is made to combine with the surface layers of the steel springs.

When zinc or cadmium are electro-deposited on springs, slight porosity of the coating is not harmful, as the anodic zinc or cadmium is corroded in preference to the cathodic steel of the spring. Corrosion of the spring is therefore only deferred by this method, as the coating itself is attacked at an appreciable rate.

With the deposition of metals, such as nickel and chromium, a surface layer is provided which is completely impervious to the penetration of the corrosive medium. In time, however, localized corrosion occurs, which is more harmful than the gradual overall corrosion which takes place with an unprotected spring. Zinc or cadmium coating, where possible, is therefore preferable to this method.

Diffusion processes are similar to electro-plating, but the method of deposition is different in that the springs are heated in protective atmospheres surrounded by metallic powders. This obviates the harmful effects associated with electro-plating, viz., the penetration of atomic hydrogen generated in the electro processes into the grain boundaries of the steel, thus causing loss of fatigue resistance. C. D. B.

MISCELLANEOUS.

1526. One Hundred Years of Progress in the Petroleum Industry. D. A. Howes. *Industr. Chem.*, 1947, **23**, 435–442.—Petroleum development from 1859 to the present day is outlined. An account of Young's work and of the birth and growth of some of the more important phases of the industry is given. F. S. A.

1527. Marketing of Oil Products. Anon. *Times Rev. Ind.*, 1947, Sept., 6–7.—A summary survey is given of the activities of the bigger oil companies who provide most of the million tons/day of petroleum products that the world requires. The chain of distribution of petroleum products is briefly outlined and a sketch map indicates the

trend of inter-continental oil movements. The principal factors governing the rôle of Middle East oil are shortly listed. V. B.

1528. Gasoline Plant Building Activity. Anon. *World Petrol.*, 1947, **18** (6), 46–49.—It is anticipated that in future (in the U.S.A.) it will be profitable to build natural gasoline plants for gas supplies which were previously considered uneconomic. A search for suitable sources of gas is being made. The paper contains a discussion on the economics of this trend. F. S. A.

1529. Bolivia Undertaking Broad Expansion of Petroleum Industry. Anon. *World Petrol.*, 1947, **18** (6), 40–41.—The paper is partly based on a report by the U.S. embassy in La Paz. The principal features of the proposed expansion consist of the adoption of a new law to permit mixed companies with foreign capital; new drilling and exploration and the construction of new pipelines and two refineries. Terrain surveys for new pipelines have been made and some of the problems in this connexion and with regard to the new refineries are discussed. F. S. A.

1530. British Refining in Interim Period. Anon. *World Petrol.*, 1947, **18** (Ann Refinery issue), 75–77.—The major developments and aspirations of the British petroleum industry are described. Developments within the Anglo-American Oil Co., Shell Chemical Manufacturing Co., Manchester Oil Refinery, Ltd., and Anglo-Iranian Oil Co. are discussed. The Socony-Vacuum plant in Birkenhead, which was damaged during the war, is now producing 10 to 12 million brl of grease and 350,000 brl of compounded oils annually. F. S. A.

1531. Restoration of French Refineries Progresses. H. M. Ballande. *World Petrol.*, 1947, **18** (Ann. Refinery issue), 60–61.—The present position of the industry in France is described. During the war installations suffered damage equivalent to 30% of their cost. 75% of the total French refining capacity was in the main battle zones. It is hoped to restore treating capacity to the 1938 level by the end of 1948, with considerable subsequent expansion. F. S. A.

BOOKS RECEIVED.

Twentieth Century Petroleum Statistics, 1947. Dallas, Texas: De Golyer and MacNaughton, 1947. Pp. 62 + xix + 62 charts. $7.50.

Although the statistics are mainly concerned with the petroleum industry of the United States, some information as to world production (1900 to 1946) and reserves (1.1.47) is given. As regards the U.S.A. the data included is remarkably complete and provides a ready source of economic information on the petroleum industry. A noteworthy feature of the publication is that each of the 62 tables is provided with a graph which gives a clear indication of the general trend of the particular aspect under survey.

Supplement to Lewis's Library Catalogue, 1944–1946. London: H. K. Lewis & Co., Ltd., 1947. Pp. 176 + iv. 5*s.* net (to Library Subscribers, 2*s.* 6*d.*).

This supplement to the 1944 edition of the catalogue of Lewis's Medical, Scientific, and Technical Lending Library brings the catalogue up-to-date to the end of 1946. The number of titles in the supplement is upwards of 3300, which are listed under authors and titles. A subject index of 526 headings is provided. The book provides a useful and convenient means of tracing current scientific and technical literature.

Proceedings of the Institution of Mechnical Engineers. Vol. 154, 1946. London: The Institution of Mechanical Engineers, 1947. Pp. 488 + xi.

Papers of interest to the petroleum technologist included in this volume are: "Some Considerations in the Design of Class I Pressure Vessels," by E. J. Heeley (10 pp.); "Notes of Design Stresses in Class I Welded Pressure Vessels," by S. F. Dorey (1½ pp.); "The Loop Scavenge Diesel Engine," by H. Desmond Carter (10 pp.); "Operation Pluto," by A. C. Hartley (6 pp.).

Journal of the Imperial College Chemical Engineering Society. Vol. 2, 1946. London: Imperial College Chemical Engineering Society, 1947. Pp. 81.

This volume of dissertations from past or present members of the Department of Chemical Engineering at Imperial College, as presented at a meeting of the Society, is a useful addition in the field of informative literature. Mainly intended for the student it is obvious that that term must be interpreted in the widest sense, and the contents of the present volume serve as an indication of the wide scope of interests covered: "The Packing of Spheres," Dr. H. Heywood; "The Use of Silver in the Construction of Chemical Plant," Dr. J. M. Pirie; "Working Conditions in Sweden," C. R. Black; "Impressions of the Swedish Wood Industry," D. H. Eastland; "Pneumatic Transport of Granular Materials," G. Hillyar-Russ; "Steam Consumption in Distillation," Dr H. E. Eduljee; "The Theory of Crystal Growth and its Application to the Design of Industrial Crystallisers," N. R. Mukherjee. Throughout, the text matter is illustrated with diagrams and photographs.

Proceedings of the A.S.T.M. Vol. 46, 1946. Philadelphia, Pa.: American Society for Testing Materials, 1947. Pp. 1629 + ix.

Among the 1946 committee reports are those for D-2 (Petroleum Products and Lubricants), D-3 (Gaseous Fuels), D-4 (Road and Paving Materials), D-8 (Bituminous Waterproofing and Roofing Materials), D-9 (Electrical Insulating Materials), and D-16 (Industrial Aromatic Hydrocarbons).

The Technical Papers section includes: "Laboratory Investigation of Anti-stripping Admixtures Used for Promoting Wetting Power and Adhesion between Bitumens and Aggregates" (J. C. Sprague), "Development of a Method of Test for Soil Bituminous Mixtures" (E. O. Rhodes and P. F. Phelan), "Water Determination in New and Used Insulating Oils by Doble Method" (F. C. Doble), "The Comprehensive Laboratory Testing of Instrument Lubricants" (G. E. Barker, G. E. Alter, C. E. McKnight, J. R. McKlveen, and D. M. Wood), and "Grease Analysis—An Analysis of the A.S.T.M. Method and Suggestions for Improvement" (R. S. Barnett, W. S. Palmer, and H. Levin).

Index to A.S.T.M. Standards. Philadelphia, Pa.: American Society for Testing Materials, 1947. Pp. 221 + viii.

Provides a ready reference to all A.S.T.M. standards in existence at December 1946. The 845 A.S.T.M. standards and 544 tentative standards are subject indexed under appropriate keywords. A numerical index is also provided.

Technical Missions to Germany and Japan.

Further official reports have been received as follows:

B.I.O.S. REPORTS.

1221. Würtemberg Shale Fields. Pp. 16.
1222. Mersol and Hostapon Processes, I.G. Farbenindustrie, Hochst. Pp. 14.
1253. A Photoelectric Colorimeter (Photoelectric Absorptionmeter) designed by Prof. R. Havemann. Pp. 13.
1274. Investigation of German Printing Ink Industry. Pp. 28.
1311. Design and Performance of the Tatra V-12 Air-cooled 14·8 litre Oil Engine. Pp. 47.
1317. Oilfield Equipment Manufactured in Germany. Pp. 11.
B.I.O.S. Evaluation Report No. 10. "Deutsche Bohrmeisterschule" (The German Drillers' School), Celle, North of Hamburg. Pp. 4.

B.I.O.S./J.A.P. REPORTS.

P.R.675. Oilfields of Hokkaido, Japan. Pp. 13.
P.R.833. Japanese Fuels and Lubricants: Fuel and Lubricant Technology. Pp. 79.

C.I.O.S. REPORTS.

XXXIII-41. Research on Preparation and Reactions of Nitroparaffins. Pp. 17.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	385 A
Geophysics and Geochemical Prospecting	394 A
Drilling	395 A
Production	397 A
Oilfield Development	399 A
TRANSPORT AND STORAGE ...	407 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	407 A
Chemical and Physical Refining	408 A
Special Processes	408 A
Refining Patents	408 A
PRODUCTS.	
Chemistry and Physics ...	411 A
Analysis and Testing	414 A
Gas	415 A
Lubricants	415 A
ENGINES AND AUTOMOTIVE EQUIPMENT	416 A
MISCELLANEOUS	417 A
BOOKS RECEIVED	419 A

AUTHOR INDEX.

The numbers refer to Abstract Numbers.

Abbey, A., 1689
Abernathy, J. H., 1593
Anderson, B. T., 1689
Arnold, C., 1689
Arnold, J. C., 1689

Bacon, T. S., 1609
Barnes, K. B., 1571, 1660, 1661, 1664, 1670, 1671
Baxter, A. D., 1716
Bloch, H. S., 1689
Bruner, F. H., 1689
Bolt, J. A., 1705
Bondi, A., 1693, 1699
Bowers, E. F., 1615
Brattain, R. R., 1694, 1695
Breese, J. L., 1689
Bruce, W. A., 1616
Bruckshaw, J. M., 1585, 1586
Burns, W. W., 1623

Campbell, O. E., 1590
Carpenter, G. B., 1696
Chaney, P. R., 1607
Clarke, L. A., 1689
Cleveland, F. J., 1689
Cobee, G. V., 1548
Cohen, C. A., 1689
Cole, R. M., 1689
Cook, W. H., 1597

Deegan, C. J., 1543, 1556, 1612, 1642, 1648
Dreyfees, H., 1689

Ellis, S. R. M., 1689

Flaxman, M. T., 1689
Fohs, F. J., 1575
Foster, A. L., 1686
Foster, F. K., 1551
Fox, R. E., 1701

Galt, J. K., 1704
Gibbon, A., 1592
Gonzales, R. J., 1644
Goulding, H. G., 1717
Gount, J. G., 1689
Gray, G. R., 1603
Gunning, H. E., 1697, 1698
Gurney, C., 1703

Halbouty, M. T., 1553
Halford, R. S., 1696
Hamblet, C. H., 1689
Hamil, A. B., 1589
Hanford, W. E., 1689
Hardin, G. C., 1553
Hatch, G. B., 1689
Hayter, B., 1689
Heller, W., 1702
Hens, E., 1689
Hill, W. B., 1621
Hipple, J. A., 1701
Hobart, H. F., 1689
Holt, B. M., 1689
Hoskings, H. A., 1618
Hunter, B. F., 1689
Hyatt, D. L., 1550

Katz, D. L. V., 1689
Kaye, J., 1715
Keenan, J. H., 1715
Kinley, M. M., 1608
Klevens, H. B., 1700, 1702

Laigret, J., 1690
Lankelma, H. P., 1689
Linnett, J. W., 1691
Lyle, H. N., 1606

McAlevy, A., 1689
McCaslin, L. S., Jr., 1591, 1651
McIntosh, A. J., 1719
Martens, J. H. C., 1559
Marty, P., 1605
Moore, P. H., 1706
Musselman, J. M., 1689

Nelson, W. L., 1684, 1685, 1708
Nowlan, H. H., 1546

Oxanne, H., 1576

Pellam, J. R., 1704
Perkins, H. W., 1607
Pevere, E. F., 1689
Poore, J. N., 1602
Pound, G. S., 1689
Price, P. H., 1559

Quarendon, R., 1707

Rasmussen, R. S., 1694, 1695
Ravitz, L., 1573
Reed, H. C., 1689
Reger, D. B., 1558
Renfro, H., 1615
Robinson, R., 1692

Sainikov, I. S., 1600
Sandoz, T. H., 1595
Schmerling, L., 1689
Semenido, E. G., 1710
Shabaker, H. A., 1689
Short, R. H., Jr., 1554, 1596, 1601, 1614
Sims, J. J., 1689
Spain, H. H., 1617
Steacie, E. W. R., 1697, 1698
Stirton, R. I., 1689
Stovall, W. S., Jr., 1613
Swenson, R. A., 1689

Taylor, R. C., 1689
Townsend, A. A., 1620
Triggs, W. W., 1689
Tucker, R. C., 1559

Ward, J. C., Jr., 1689
Warrick, H. R., 1689
Weber, G., 1547, 1599, 1619
Welge, H. J., 1616
Wheeler, R. R., 1552
Williams, J. W., 1689
Williams, N., 1549, 1598, 1611, 1645, 1646
Willibrand, P. H., 1550
Willson, C. O., 1560, 1561,
Wolf, A., 1709
Woodward, S. W., 1588
Wrightsman, G. G., 1617

Zaba, J., 1594
Zajac, T. S., 1610
Zobell, C. E., 1532
Zucco, P. S., 1695

OILFIELD EXPLORATION AND EXPLOITATION.

Geology.

1532. Bacterial Release of Oil from the Sedimentary Materials. C. E. Zobell. *Oil Gas J.*, 2.8.47, **46** (13), 62.—Laboratory work shows that bacteria can liberate oil from oil-bearing sediments by several mechanisms. Solution of calcareous matter may be

a most important mechanism. Hydrocarbons may be liberated from organic matter. Bacteria may decompose sulphate minerals.

Carbon dioxide, methane, and hydrogen produced bacterially may promote oil flow. Bacterially-formed detergents can aid in liberating oil from sediments, and bacterial growth on solid surface may displace oil.

Oil in small amounts has been released from samples of Athabaska tar sand in the laboratory.

Sulphate-reducing bacteria seem to be the most versatile oil-releasing organisms, but methane, hydrogen-producing, and other anaerobic bacteria may be more effective if they can be injected into oil-bearing formations along with appropriate nutrients.

More research is needed on these problems. G. D. H.

1533. November Exploration Exceeds 1945 Period. Anon. *Oil Wkly*, 30.12.46, **124** (5), 49.—419 exploratory wells were completed in U.S.A. in November 1946 to give a total of 4035 wells for the first 11 months. 70 of the November tests were producers, 37 discovering oil. 11 oilfields were extended. A new Weber sand field, Elk Springs, was opened in Colorado.

The results of the November exploratory completions are summarized by States and districts. A table lists the 1946 discovery well with some pertinent data.

G. D. H.

1534. U.S.A. Crude Reserves. *Oil Wkly*, 20.1.47, **124** (8), 48.—At the end of 1945 32 U.S.A. companies held 16,979,400,000 brl of reserves, 81·5% of the total U.S. reserves. Standard Oil Company (N.J.) held 3,500,000,000 brl of reserves; the Texas Company held 1,500,000,000 brl. A table shows the domestic and foreign reserves of the companies, but data on foreign reserves are incomplete. Five of the companies together hold 15,470,000,000 brl of foreign reserves. G. D. H.

1535. 4831 Exploratory Wells Were Completed in 1946. Anon. *Oil Wkly*, 27.1.47, **124** (9), 50.—432 exploratory wells were completed in U.S.A. in December, making the 1946 total 4831. 17·1% of the December wells were successful, and for the whole year 19·4% were productive. 1946 had 515 oil discoveries of which 310 were new fields; there were 104 gas discoveries, 75 being new fields, and 72 distillate finds, including 30 new fields.

A table summarizes by States and districts the exploratory well results in December and throughout 1946; a second table groups the discoveries according as they are oil, gas, or distillate discoveries, new fields or new pays, and extensions.

The new oil, distillate, and gas fields, and new pays discovered in U.S.A. in December 1946 are listed with the salient points noted. G. D. H.

1536. Wildcat Drilling at New Peak. Anon. *Oil Wkly*, 10.2.47, **124** (11), 130.—During 1946, 4830 exploratory tests were drilled in U.S.A. (the 1945 figure was 4510). The 1946 tests yielded 935 discoveries, of which 687 were new oil, distillate, or gas fields, or sands, and 248 were extensions. 513 new oilfields or pays were found, 308 being new fields. 1946 gas discoveries numbered 103, including 74 new gas fields. Texas yielded 118 new oilfields and Illinois 30.

A table gives yearly from 1937 the numbers of new fields and pays discovered, with a breakdown into oil, gas, and distillate fields and pays. Further tabulations by States give the numbers of oil, distillate, and gas fields, pays and extensions opened in 1946, with the footage of the wells, and an analysis of the dry tests according as they were wildcats, new pay tests, or outposts. G. D. H.

1537. Wildcatting Success Below Average Ratio. Anon. *Oil Wkly*, 10.2.47, **124** (11), 136.—During 1946, 9·8% of the strict wildcats drilled in U.S.A. were successful. The percentage success for the 10 years 1937–1946 was 10·8.

A table gives by States and districts for 1946 and 1937–1946 the numbers of strict wildcats and productive wildcats, and the total numbers of wells completed in U.S.A. G. D. H.

1538. U.S. Crude Reserves Reach All-time Peak. Anon. *Oil Wkly*, 10.2.47, **124** (11), 139.—U.S. oil reserves were estimated to be 21,287,673,000 brl on January 1, 1947.

At the beginning of 1946, the figure was 20,826,813,000 brl. During 1946 new reserves proved amounted to 2,192,749,000 brl.

Tables give the proved reserves at the end of each year from 1936, with the ratio of reserves to annual production for each year, the new reserves proved and the production during each year from 1937, the proved reserves at the beginning and end of 1946, and the 1946 production by States and districts. G. D. H.

1539. Salient Data on Productive Exploratory Wells Completed in U.S.A. in 1946. Anon. *Oil Wkly*, 10.2.47, **124** (11), 200.—The U.S. 1946 productive exploratory completions are listed by States with the following information: name, County, field, company, location, date completed, total depth, completion depth, name, character, and age of producing formation, initial production, choke, and oil gravity. G. D. H.

1540. January Exploratory Drilling Rate High. Anon. *Oil Wkly*, 24.2.47, **124** (13), 61.—414 exploratory wells were completed in U.S.A. in January 1947, and 71 were successful. 52 discovered new sources of oil and 5 extended production. The main discovery appeared to be Howard 1, in Garvin County, Oklahoma. This well, lying in the Anadarko basin, is reported to have flowed 1000–2000 brl/hour before being checked.

A table summarizes the results of the January exploratory completions, by States and districts. A further table compares the overall results with those for January and December, 1946, while the January 1947 discoveries are listed with some details. G. D. H.

1541. A.P.I. and A.G.A. Oil–Gas Figures. Anon. *Oil Wkly*, 10.3.47, **125** (2), 38.—The A.P.I. estimated U.S.A. crude reserves to be 20,873,560,000 brl, in addition to 3,321,027,000 brl of natural gas liquids.

Tables summarize the A.P.I. reserve estimates for each year since 1937, giving the production, reserves added through revision and extensions, and through new pools for each year, in addition to the total reserves. Similar data for 1946 are given by States. G. D. H.

1542. Peak Wildcatting Gain Despite Shortages. Anon. *Oil Wkly*, 31.3.47, **125** (5), 58.—369 wildcats were completed in U.S.A. in February, and 76 were productive. Oil discoveries numbered 47, gas discoveries 6, and distillate discoveries 9. Extensions were made to 14 fields.

The Concord Central field, White County, Illinois, may be Illinois' best find in February.

Tables summarize the results of February's wildcat completions, both by States and by types. The February discoveries are listed with information on outstanding points. G. D. H.

1543. Five Major Fields Needed to Maintain Reserves. C. J. Deegan. *Oil Gas J.*, 26.7.47, **46** (12), 187.—About 15,000 oilfields are believed to have been found in U.S.A., but those with reserves exceeding 100,000,000 brl total only 105. These major fields have 63% of the proven reserves and accounted for over 50% of the output in the first half of 1947. Omitting East Texas, the average size of a major field is about 250,000,000 brl.

The maintenance of reserves requires the discovery of about 2,000,000,000 brl of oil in 1947, and if 60% of the past production has come from the major fields, new discoveries of the latter type should have reserves of 1,200,000,000 brl—the equivalent of five average major fields.

About 5000 exploratory tests are planned, but of these 1500 may be extension tests. In 1945–46 15% of the new field tests succeeded, and hence if the same success ratio holds, 525 fields of all sizes should be found in 1947. If 1% of these are major fields, there is the prospect of obtaining the requisite 5 major fields.

As the oil requirements rise major discoveries will be needed.

38 major fields (reserves exceeding 100,000,000 brl) were found in 1921; and in succeeding 5-year periods up to 1940 the figures were respectively 13, 21, 12, and 16.

A table lists the major fields with the date of discovery, estimated ultimate output,

cumulative production, remaining reserve, production in first halves of 1946 and 1947, and age of producing horizon. G. D. H.

1544. Light Oil Strike Near Santa Maria. Anon. *Oil Gas J.*, 28.6.47, **46** (8), 163.—A well in 4-8n-33w, in the Santa Maria district of Santa Barbara County, California, has flowed 314 brl of 36·6° A.P.I. oil from the Miocene at 4805–4830 ft. A cluster of fields round this strike produce lower gravity oil. The well is 1½ miles southeast of Orcutt. G. D. H.

1545. Pemex Producer. Anon. *Oil Wkly*, 17.3.47, **125** (3), 29.—There are indications that a well completed in a new area in the northern part of the State of Veracruz will be a satisfactory producer. G. D. H.

1546. Indiana's Output. H. H. Nowlan. *Oil Gas J.*, 6.9.47, **46** (18), 66.—The southwestern part of Indiana lies in the Illinois basin. Ten pay horizons are present and wells cost $5000–$25,000. Numerous wells drilled 30 years ago still produce 5–10 brl/day, at depths less than 1500 ft. At Mount Vernon 24 wells have averaged 119,000 brl each since 1941, while at New Harmony 33 wells have averaged 105,000 brl each from eight pays.

The pools in this area are small and the sands are commonly lenticular. Oil is obtained from Pennsylvanian, Mississippian, and Devonian beds.

A map shows the producing areas, and a composite electric log section indicates the producing horizons. A table lists the more recently discovered pools, with the number of wells and pay zones, daily, cumulative, and estimated ultimate production. G. D. H.

1547. Delhi—Biggest Stratigraphic Trap Since East Texas. G. Weber. *Oil Gas J.*, 14.6.47, **46** (6), 108.—The Delhi–Big Creek production has passed 10,000,000 brl in 2½ years. The field is in Louisiana on the southern edge of the Monroe uplift. The discovery well was drilled in 1944 and found oil production in the Holt sand of the Paluxy at 3280–3290 ft. A series of producing sands were found in a belt some 18 miles long. 331 wells have been drilled. Daily production is 25,000–30,000 brl.

The uplift of the Monroe Uplift–Sharkey Platform began at the end of the Lower Cretaceous and continued into early Tertiary times. The basal Tuscaloosa, Paluxy, and Upper Glen Rose beds were truncated and the impervious Monroe was laid on them. The Barrier sand connects various truncated Paluxy beds. In general, production is limited to the north by truncation, to the south and east by water, and to the southwest and west by lensing. Active water-drive exists in the Holt–Bryan. Ultimate recovery may be 200,000,000 brl.

Data are given on drilling costs and on the characteristics of the main reservoirs. G. D. H.

1548. Lithology and Thickness of the Traverse Group in Michigan Basin. G. V. Cohee. *Oil Gas J.*, 5.7.47, **46** (9), 90.—Most of the oil produced in southwest Michigan has come from the Traverse group, and some Traverse production has been obtained elsewhere, especially in the central basin area.

The Traverse group is thickest in the area of Saginaw Bay, being about 875 ft. Southwards it thins to less than 100 ft in southwestern Berrien County. Part of this thinning is due to the absence of the Bell shale and Squaw Bay limestone.

There is thinning over major anticlines, suggesting movement in Traverse times. The centre of the basin is 3500 ft lower than the Traverse outcrop; the average dip being 38 ft/mile. The Traverse structure conforms with that of the Dundee–Rogers City, and in the centre of the basin are dominant northwest–southeast folds. In the southwest there are also north–south and northeast–southwest folds. The majority have over 100 ft of closure with oil only in the upper 40–60 ft.

Production in southwest Michigan is from porous dolomite overlying or associated with the uppermost chert layer in the uppermost part of the Traverse limestone. The thickness is 3–8 ft. In some areas there is a second slightly deeper producing horizon.

A map gives stratum contours on the top of the Traverse. The Traverse producing fields are noted and oil and gas possibilities are discussed. G. D. H.

1549. Brookhaven Field. N. Williams. *Oil Gas J.*, 14.6.47, **46** (6), 94.—The Brookhaven field of Lincoln County, Mississippi, now extends over an area 6 miles from north to south and 2–3 miles from east to west. There is a central " bald " area of 1000–1200 acres. The field is not yet fully defined.

66 producing wells and 13 dry holes have been drilled. Up to May 1947 the production was 2,512,650 brl. In January production exceeded 14,000 brl/day.

There is an elongated anticline, possibly over a deep salt swell. Some faulting is present. Production is from the lower part of the Tuscaloosa at depths of 10,138–10,541 ft. Closure is 429–517 ft. There are three main producing zones, but sands wedge out frequently. Effective sand thickness averages 30–35 ft. Permeability ranges 0–2700 m, and is irregular. Original reservoir pressure is estimated to have been 4600 p.s.i. and the bubble point is 2200 p.s.i. The abandonment pressure may be 320 p.s.i. The recoverable reserve may be 45,415,000 brl. Gas injection may be undertaken to enhance recovery by maintaining pressure above 2200 p.s.i. Gas might be purchased from Gwinville, 35 miles to the northeast. Pressure maintenance might give a recovery of 64,212,000 brl.

Brief notes on the early development and information on drilling are given.

G. D. H.

1550. Sohio's 1 Howard. F. H. Willibrand and D. L. Hyatt. *Oil Gas J.*, 12.7.47, **46** (10), 67.—1 Howard was spudded in November 1945 and completed at a total depth of 10,234 ft in January 1947. It is on the Eola structure, a minor fold adjacent to the Arbuckle Mountain front in Oklahoma, and is narrow. Permian to Ordovician beds were penetrated. Low-gravity oil was noted in the Pontotoc, a fair show was seen in the Hunton. 4 oil sands were met in the Bromide member of the Simpson Group. On a 1½-in choke production at the rate of 100 brl/hr was obtained from the Bromide, with a G.O.R. of 1000 cu. ft/brl. The oil gravity was 40° A.P.I.

Details of drill-stem tests and notes on the drilling are given. G. D. H.

1551. Carthage Gas Field Development. F. K. Foster. *Oil Wkly*, 23.12.46, **124** (4), 33.—The Carthage field of Panola County, Texas, was opened in 1936. The discovery well was completed in the Hill zone at 4880–4890 ft. Succeeding wells obtained gas in the Lower Pettit and Travis Peak. In 1943 a well gave 112,000 M.c.f. from the Upper Pettit and 79,000 M.c.f. from the Lower Pettit.

The beds penetrated range Wilcox (Eocene) to Smackover (Jurassic). The formations are described. There is an elongated dome. The four producing horizons are at depths of 4800 to 6440 ft, the Upper and Lower Pettit being most prolific.

The Hill zone produces over 16,000 acres and has a fairly even permeability. The Upper Pettit is more variable and shows variation at different levels, and the same is true of the Lower Pettit. Both are oolitic. The Travis Peak is sand with some silt, and as many as 8 separate producing sands have been noted.

The field extends over 300,000 acres, but is not fully defined on the east. Permeabilities are generally low and it is doubtful whether 1 well to 640 acres will give adequate drainage. It is considered to be the largest gas condensate reserve in U.S.A. A few wells have produced some oil, but oil wells seem unlikely to occur. Several wells on the west have found water directly below the gas. One well has found salt.

Structure and isopachyte maps are included, and all the wells are listed with depths, initial outputs, etc. G. D. H.

1552. Western Delaware Basin Oil Possibilities. R. R. Wheeler. *Oil Wkly*, 24.3.47, **125** (4), 22.—Surface structures in the Delaware basin of West Texas and southwest New Mexico are at times non-tectonic in origin, but due to solution or secondary distortion in the Permian evaporite series. Moreover, the evaporites have made seismic work difficult. Closed structures are rare and poor recoveries have been obtained from the Delaware sand section.

The west flank of the Delaware basin has in the east an area obscured by Late Permian evaporites, and in the west outcrops of the Delaware Mountain group. The latter is easily mapped, but the former is difficult, and only gravity or magnetic work seem suitable for locating structure.

The Delaware Mountain group consists of sandstones of variable porosity, interbedded with rich organic shales and limestones. There may also be pre-Permian oil

objectives in this area, including the Simpson and Ellenburger. The Lower Delaware tends to be coarser than the Upper. Source rocks are plentiful.

Mapping has revealed little but anticlinal noses, at times closed by cross-faults. There may be a large structure on the projection of the Huapache Arch arch.

The Permian rests on bevelled Ordovician to Pennsylvanian rocks, and the later Permian lies on tilted and locally truncated early Permian.

The Huapache flexure shows signs of renewed movement. Repeated eastward tilting is indicated. Lensing and stratigraphic trap possibilities are indicated in the Delaware sequence, and these may lie in the basinward flank of the continuation of the Huapache trend. Closed folds may exist in pre-Permian oil objectives.

Oil seeps occur along Delaware Creek. G. D. H.

1553. Trends in Petroleum Geology of the Gulf Coast. M. T. Halbouty and G. C. Hardin. *Oil Gas J.*, 31.5.47, **46** (4), 136.—During 5 years following the discovery of Spindletop 29 domes were discovered in the Gulf Coast area, and up to 1924 there were 47 discoveries. From 1924 to 1933, 74 domal structures were found by geophysics. The earlier discoveries were associated with shallow piercement-type salt masses; the later discoveries were over deep-seated salt intrusions. In the past 10 years fields connected with faults have been more prominent.

The area has been very thoroughly explored geophysically, and practically all shallow geological and geophysical prospects have been drilled. A prolific source of relatively shallow production is the flanks of piercement-type salt domes where pinch-outs and unconformities provide traps.

Deeper drilling will be necessary to open many future discoveries in the Gulf Coast area. There are indications that while the cost of drilling exploration tests has risen, the chances of discovering new fields have decreased. Many of the deeper discoveries of recent years have not been of major importance. Most of them had small proven areas and high gas/oil ratios.

The deep Frio and Hackberry trends offer considerable possibilities for finding new fields. Attention is also being paid to the Wilcox–Yegua trend.

Salt domes are likely to occur offshore. G. D. H.

1554. Offshore Development in Gulf Coast Promises to be Well Under Way by End of 1947. E. H. Short. *Oil Gas J.*, 31.5.47, **46** (4), 228.—A steel-drilling platform is now being built 29 miles offshore in the Gulf of Mexico. About 10 years have elapsed since the first well was drilled in the Gulf proper, but at low tide the water was only 13 ft deep. 10 wells were drilled from one platform to give the Creole field.

Early geophysical work in the Gulf did not extend more than 3 miles offshore, but in 1944 work was carried out to 26 miles, and now over 50 miles has been reached.

All leases taken so far are well on the shore side of the 10-fathom line.

The State of Texas will offer 5760-acre blocks beyond the 3-miles limit to 27 miles out. G. D. H.

1555. Another East Texas County Produces. Anon. *Oil Gas J.*, 21.6.47, **46** (7), 139.—A well in San Augustine County, 3¾ miles north of San Augustine and 1 mile west of Bland Lake, has found oil in the Pettit zone of the Glenrose. 42° oil is produced at the rate of 85–100 brl/day on a $\frac{1}{4}$-in choke from 8130–8160 ft. Acidization improved the production rate. G. D. H.

1556. Unusual Geology with Multiplicity of Pay Zones, Features South Haldeman Field. C. J. Deegan. *Oil Gas J.*, 23.8.47, **46** (16), 91.—South Haldeman field, Jim Wells County, Texas, was opened in February 1947. It is west of Seeligson and associated with the regional Sam Fordyce–Vanderbilt fault zone. South Haldeman is a horst. The producing sands are more or less lenticular as at Seeligson, and are in the Frio and Vicksburg at depths of 4200–5600 ft. Outputs in the 4 wells completed range 54–216 brl/day, and the oil gravities are 40–48° A.P.I. Gas/oil ratios range 338 to 912 cu. ft./brl. The proven reserve is estimated at 10,000,000 brl.

A map and reduced electric logs are included. G. D. H.

1557. Union Oil Plans Large Programme of Exploration in Washington State. Anon. *Oil Gas J.*, 3.8.47, **46** (17), 64.—Union Oil Phoebe Parker *et al* was completed at 1912 ft

in a badly faulted formation, and was dry. A second test is under way at Oyehut, Grays Harbor County, ½ mile from the Pacific.

Union has leased 200,000 acres in W. Washington. The area has Oligocene and Lower Miocene organic shales, and some high-gravity oil has been produced from Miocene and Oligocene beds on Hoh River, on the western side of Olympic Peninsula. There are odours of gas at many points from Gray's Harbor to near Cape Flattery. Ten tests are planned. Two in Oyehut area will be 2000 ft and 3000 ft deep.

G. D. H.

1558. Expanding Frontiers of Natural Gas in West Virginia. D. B. Reger. *Oil Wkly*, 20.1.47, **124** (8), 36.—Oil and gas were first found in West Virginia in salt borings near Charleston in 1808 at a depth of 58 ft. The subsequent history of natural gas production in this State is described briefly. In 1917 the output reached a peak of 308,617,101 M.c.f. Production was largely from the sands of the Pottsville, Pocono, and Catskill series, as well as from Chemung. The output fell and was 100,540,000 M.c.f. in 1932. In 1933 and 1934 oil and gas were obtained from the Oriskany northeast of Charleston at depths of about 5000 ft. This led to renewed activity and the completion of a few big wells on sharply folded mountain anticlines.

The Newberg sand of the Silurian has given some gas in western Wayne County and northern Boone County. A well in western Roane County reached the top of the Trenton at about 9000 ft.

Gas production reached a new peak of 223,787,000 M.c.f. in 1943. The lateral expansion of production since 1930 and the prospects of deeper developments are discussed.

A map shows the oil and gas areas, and a table gives the stratigraphic sequence with the thickness and producing sands. G. D. H.

1559. Future of Oil in W. Virginia. P. H. Price, R. C. Tucker, and J. H. C. Martens. *Oil Gas J.*, 16.8.47, **46** (15), 104.—Oil was first produced in W. Virginia in 1860 and the peak year's output of 14,000,000 brl was reached in 1901. Production has been obtained from more than 20 sands, the most important being of Upper Devonian and Lower Mississippian age, but there has been Pennsylvanian production. The fields are in the northern and western part of the State. Proved reserves at the end of 1946 were estimated at 35,655,000 brl and cumulative production was 432,706,000 brl. Further oil should be recoverable by water-flooding, and this is not included in the above estimate.

Almost all production has been shallower than 4000 ft. Deeper horizons cannot be considered to have been adequately tested, and these offer possibilities. The prospects of certain horizons and areas are discussed. G. D. H.

1560. Full-Scale Exploration Under Way by Navy in Alaska. C. O. Willson. *Oil Gas J.*, 9.8.47, **46** (14), 62.—During June 2 wildcats were spudded in Naval Reserve No. 4, one at Umiat and one at Cape Simpson. 1 Umiat, completed in 1946 and drilled to 6005 ft, had showings of oil at five depths. The second Umiat well is 5 miles east of the first, and structurally higher. A nearby shallow core hole has given a little oil. Four geological crews and two seismograph parties are operating.

The history of operations in this area is given. G. D. H.

1561. Seeking Arctic Oil. C. O. Willson. *Oil Gas J.*, 23.8.47, **46** (16), 78.—Many of the latest exploratory techniques are being employed in searching for oil in naval Petroleum Reserve, No. 4, in Alaska. Maps show the areas explored by surface geology, aerial photography, airborne magnetometer and gravity meter, surface gravity meter, and seismic work, and the fold trends and seepages. The area has 10,000–15,000 ft of Upper Cretaceous beds. The geology is briefly described, and there are brief notes on the geophysical work. A summary of formation test data on 1 Umiat, and the electrical log are given. G. D. H.

1562. Liquid Bitumen Reserve Found. Anon. *Oil Wkly*, 20.1.47, **124** (8), 29.—A liquid bitumen reserve of 400–500 million brl is reported to have been found on the west side of the Mildred–Ruth Lakes area, 20 miles north of Fort McMurray, Canada.

G. D. H.

1563. Imperial Leduc 1 is West Canada's Best Producer Outside Turner Valley. Anon. *Oil Wkly*, 24.2.47, **124** (13), 24.—Leduc 1, a wildcat 16 miles southwest of Edmonton, had an initial flow of 9000 brl/day of 36·7-gravity oil. A test of the Lower Cretaceous at about 4300 ft gave 6000 M.c.f./day of gas with a good show of light oil. At 5029 ft in the Devonian a porous limestone was met, and this gave oil and gas. This is the producing horizon; its gas/oil ratio is low. Leduc 2 is being drilled 1¼ miles down the flank to the southwest.

32 miles southeast of Leduc 1, Wetaskiwin 1 is drilling below 5700 ft. G. D. H.

1564. Sinclair Panama Starts Colon Island Wildcat. Anon. *Oil Gas J.*, 23.8.47, **46** (16), 61.—A wildcat has been spudded on Colon Island, off Bocas del Toro, Panama. G. D. H.

1565. Spring Hill 4 Test Runs Low. Anon. *Oil Wkly*, 31.1.47, **124** (7), 31.—Spring Hill 4 in Chile is reported to be 65–70 ft lower structurally than No. 1. G. D. H.

1566. Chile's Spring Hill 4 Abandoned; No. 5 Planned. Anon. *Oil Wkly*, 10.2.47, **124** (11), 262.—Spring Hill 4 was abandoned at 7479 ft, having reported shows, but having given no oil in drill-stem tests. Spring Hill 5 will be drilled 1100 ft southwest of No. 3. G. D. H.

1567. Chile's Sixth Spring Hill Well Comes in a Producer. Anon. *Oil Gas J.*, 28.6.47, **46** (8), 80.—The Sixth Spring Hill well is a producer, and the area is now estimated to have a production of 1600 brl/day. G. D. H.

1568. Seventh Test Completed in Spring Hill Field: Anon. *Oil Gas J.*, 6.9.47, **46** (18), 45.—Spring Hill 7 (Chile) has been completed, but no flow test has been made. No. 8 is about 5000 ft deep. G. D. H.

1569. Tibu Cretaceous Production Enlarged by Colombian Test. Anon. *Oil Wkly*, 23.12.46, **124** (4), 30.—K-12 on the southwest side of the Tibu field was drilled to 10,875 ft, and had showings just above the basement. The well was completed at 8732–8882 ft for 914 brl/day of 39-gravity oil on a ¾-in choke. This well is several miles from the nearest production. K-28 on the northeast flank has been drilled to 10,327 ft, and is testing several horizons higher in the hole. G. D. H.

1570. Tibu Cretaceous Testing Continues in Well K-28. Anon. *Oil Wkly*, 10.2.47, **124** (11), 262.—K-28 has been drilled to 10,327 ft, and the Cretaceous limestone is being tested, so far without very encouraging results because of tight formations. At several points flows of 40-gravity oil at the rate of 30–40 brl/day have been obtained K-21 on the southwest side of the Tibu field has flowed 43-gravity oil at 650–1500 brl/day. Best results have been obtained at 8600–8800 ft. K-21, drilled to 10,876 ft was Colombia's deepest test. G. D. H.

1571. Exploration in Colombia Extends from Caribbean to Llanos. K. B. Barnes. *Oil Gas J.*, 12.7.47, **46** (10), 44.—Expenditure on exploration work in Columbia during the past few years have probably exceeded $100,000,000.

The El Dificil field, 50 miles southeast of Barranquilla, produces from an Upper Oligocene limestone at about 5800 ft. The present potential of the field is about 2500 brl/day. High-pressure gas has been encountered in the Pinto area. At El Tablon a well has found gas.

A tightly folded anticline has been outlined by nine shallow tests at Floresanto. Two 75-brl 40-gravity producers have been obtained in the Middle Miocene. One is at 650 ft, the other at 1200 ft. The deep oil possibilities are being explored.

La Salina 1 was completed in Eocene sands at 1770–2230 ft for 75 brl/day of 21° A.P.I. oil. Highly fractured beds occur at Cantagallo where 3 fair and 2 small producers have been completed in addition to 2 gas wells and 5 dry holes. 1 Velasquez on the Teran–Guaquaqui property is reported to have a production of 421 brl/day from 6954–7120 ft. Other structures have been tested, and notes on these are given. G. D. H.

1572. Second Union Company Test is Commenced in Paraguay. Anon. *Oil Wkly*, 10.3.47, **124** (2), 39.—The first Union test was abandoned at 7579 ft in January, and a second test will soon begin. G. D. H.

1573. Peruvian Montana. L. Ravitz. *Oil Wkly*, 3.3.47, **125** (1), 22 (International Section).—Three major oil companies are exploring the Peruvian Montana, but so far only one has found production. The seventh well at Ganzo Azul was completed in 1946 and flowed 3700 brl/day on test.

The activities in eastern Peru are briefly described. The Peruvian Government is preparing to drill at Santa Clara near Orellana on the Ucayali, while the Cia Puerana de Petroleo El Oriente is preparing to drill at Puerto Oriente, near Contamana. G. D. H.

1574. Pelayo Concession Well Completed as Producer. Anon. *Oil Wkly*, 23.12.46, **124** (4), 30.—Tucupido 1, on the Pelayo concession, Venezuela, has produced 257 brl/day of 40·8-gravity oil on a ¼-in choke from 7473–7488 ft. G. D. H.

1575. Vast Area in Middle East Awaiting Exploration and Development. F. J. Fohs. *Oil Gas J.*, 19.7.47, **46** (11), 46.—Important oil deposits occur in northeast Iraq, extreme western Iran, and eastern Arabia, and will extend slightly into Turkey and Syria. Folds to the west in Syria, Lebanon, Trans-Jordan, and Palestine are principally in limestone beds without adequate cap-rock in most areas.

In Saudi Arabia is a primary oil reserve area of 221,000 square miles. The beds dip eastward from the Arabian foreland. Between the Zagros and Elbruz mountains in the northeast are less important basins. These are in northern Iran and southwest Afghanistan. Domes exposing Cretaceous beds are present, and the area may yield pools of the Rocky Mountain type. Other basins occur to the south in Iran and to the east in central Baluchistan.

16,000,000,000 brl of proven reserves exist in the Persian Gulf basin, and there is an indicated reserve of 26,500,000,000 brl. Expectations may be as high as 100,000–150,000 million brl.

The first-grade areas total 649,000 square miles; second-grade areas 131,000 square miles, and third-grade areas 195,000 square miles. There are 20 Middle East fields with 150 wells, and 3 pools in Egypt. During 1946 the daily production of the Middle East averaged 729,040 brl.

Russia has important oil reserves in sedimentary basins to the north. Including Sakhalin Russia's 1946 output averaged 454,794 brl/day. Russia controlled a further 120,289 brl/day. Russia's reserves may be 10,000,000,000 brl and the ultimate expectation may be 100,000,000,000 brl. G. D. H.

1576. Egyptian Exploration Programme Most Intense. H. Ozanne. *Oil Wkly*, 3.3.47, **125** (1), 10; 7.4.47, **125** (6), 3 (International Section).—The history of oil development in Egypt since 1880 is briefly described. Currently, production is about 30,000 brl/day from Ras Gharib and Hurghada. The former has produced 60,000,000 brl and the latter 28,000,000 brl.

At present concession terms are the subject of individual company negotiations. A short description of the activities of Anglo-Egyptian Oilfields, Ltd., is given, including notes on the Sudr discovery.

Socony-Vacuum's work in Egypt is described, together with that of Standard Oil Co. of Egypt. Lists of the wildcats drilled by the various companies are given. G. D. H.

1577. Haiti Wildcat. Anon. *Oil Wkly*, 3.3.47, **125** (1), 28 (International Section).—A wildcat in Haiti has reached 6500 ft. G. D. H.

1578. Billion and Half of Reserves Added by Completion of Abqaiq No. 10. Anon. *Oil Wkly*, 3.3.47, **125** (1), 26.—Abqaiq No. 10 is over 2 miles west of previous production. It reported 220 ft of limestone with a porosity of 22% and flowed 11,000 brl/day on test. Saudi Arabia reserves are now estimated as Abqaiq 5,000,000,000 brl, Dammam 600,000,000 brl, Qatif 50,000,000 brl, and Abu Hadriya 140,000,000 brl. G. D. H.

1579. Hungary Plans to Exploit Gas–Oil Field Near Lispe. Anon. *Oil Wkly*, 17.3.47, **125** (3), 29.—In 1946 oil and gas were discovered in the region of Igal, near Kaposvar, southwest Hungary. This area is to be investigated further.

A 7000 M.c.f. gas well has been completed at Ujudvari in the Lispe area.

G. D. H.

1580. Gulf Affiliate to Test Salt Dome in Jutland. Anon. *Oil Gas J.*, 19.7.47, **46** (11), 49.—An exploratory well is to be drilled near Holstebro, Jutland to test a deep salt dome. A wildcat in southwest Sweden showed some oil saturation, but was completed in a salt-water sand. G. D. H.

1581. Small Show in Spain. Anon. *Oil Wkly*, 23.12.46, **124** (4), 30.—A well in Burgos Province encountered a small show of oil at 750 ft. G. D. H.

1582. Swedish Oil Discovery Official. Anon. *Oil Wkly*, 31.1.47, **124** (7), 31.—Traces of oil have been found in a well drilled to 6230 ft at Hoellviken, Sweden. G. D. H.

1583. Victoria, Australia. Anon. *Oil Wkly*, 3.3.47, **125** (1), 16 (International Section).—In 1924 a test at the head of Lake Bunga struck a water flow with traces of oil and some methane at 1070 ft. Metamorphics were met at 1200 ft. In 1926 a well 2 miles to the west found emulsified oil in glauconitic rock occurring at 1210–1272 ft. These were the first wells drilled in the Lakes Entrance area, where some 50 tests have been sunk, and most have had some oil shows. Total production is about a few thousand brl. The oil is in an Upper Oligocene glauconitic series, and in a lens some 10 miles by 2 miles, and appears not to have migrated. Almost all the oil produced has been emulsified. The deepest well was 3400 ft.

21 tests have been drilled in the Bengworden area, the depths ranging 1000–4000 ft, but none had showings. 40 tests have been drilled in the Longford area, 50 miles southwest of Lakes Entrance. None was deeper than 1500 ft. No shows were found in shallow tests drilled in the Dartmoor district. A 7305-ft. test near Glenelg had no shows.

Tables summarize the oil drilling carried out in Victoria. A map shows the areas in which drilling has taken place. G. D. H.

1584. Oil Discovery Reported in Test on Cebu in Philippines. Anon. *Oil Gas J.*, 19.7.47, **46** (11), 44.—Reports have been made of the discovery of oil in northern Cebu. Oil shows have been found at about 1600 ft and 8200 ft, but commercial possibilities are undetermined. The test is said to be over a fair-sized salt dome.

Late in 1941 an 8300-ft test apparently discovered oil sands, but the hole had to be plugged before a test could be made. G. D. H.

Geophysics and Geochemical Prospecting.

1585. Geophysical Prospecting and Petroleum Discovery. J. McG. Bruckshaw. *Petroleum*, May 1947, **10**, 98.—This is the first of a series of six articles describing the various techniques employed in the geophysical exploration for petroleum.

F. W. H. M.

1586. Magnetic Method of Geophysical Prospecting. J. McG. Bruckshaw. *Petroleum*, June 1947, **10**, 122.—This second article in the series describes the use of the magnetic method. F. W. H. M.

1587. Geophysical and Core Drilling Activity During 1946. Anon. *Oil Wkly*, 10.2.47, **124** (11), 240.—419 geophysical and core-drilling crews were active in U.S.A. at the end of 1946. 369 were geophysical crews, and of these 251 were seismic, and 95 gravity meter.

A table gives by States the numbers of each type of crew active on January 31, June 30, and December 31, 1946. G. D. H.

1588. Unique Tripod Speeds Water Gravimetric Survey. S. W. Woodward. *Oil Wkly*, 3.3.47, **125** (1), 50.—The tripod is a welded, braced, three-legged structure,

with a plate on one side near the bottom, this plate causing the tripod to rise in the water when towed by the top. The height is about 17 ft, and it can be used normally with winds of 15 m.p.h. Trials have been made with a 26-ft tripod.

With stations 2600–3000 ft apart and good conditions gravity-meter readings can be made at 9–10-min intervals. Under typical Bahamas conditions the average time was 12 min made up as follows: 5½ min, travel between stations; setting up tripod 1 min; depth reading, setting up, and reading meter 3½ min; removing meter and preparing to move to next station 2 min.

Towing the tripod does not seriously reduce the boat's speed, and the tripod draws less water than the boat.

Photographs show the tripod in use. The tripod has been employed so far only where the sea floor is firm. G. D. H.

1589. Portable Equipment Expedites Inland Marine Seismic Surveys. A. B. Hamil. *Oil Gas J.*, 31.5.47, **46** (4), 146.—Portability of all equipment is essential in areas difficult of access. A brief description is given to the entire seismic recording equipment, including geophones and cables, which weighs only 250 lb and is easily carried by five men. A portable drilling unit is described. Equipment for drilling 50 holes, including fuel, tools, and bits, can be carried and operated by four men. Shooting and recording equipment is mounted in or on trucks in such a manner that it can quickly be removed when it has to be carried. G. D. H.

1590. Principal Uses of Fluorologs. O. E. Campbell. *Oil Wkly*, 30.12.46, **124** (51), 41.—Fluorologs are designed to determine the presence or absence of commercial oil accumulations ahead of the drill, or laterally from the well; to detect, and evaluate oil or gas shows in the well, and to permit the correlation of the rocks. It is considered that rocks overlying an oil accumulation show higher fluorescence intensities than those in barren territory. These higher intensities arise within 2000 ft of the surface.

Cuttings and cores are used in compiling fluorologs. The fluorescence intensity is measured photometrically. Wells which produce show fluorescence intensities of at least 0·25 ferg within 2000 ft of the surface. A value of 1·25 fergs indicates a definitely commercial zone. Observations are made on composite samples extending over 200 ft until a significant value is noted, and then the different parts are examined separately for detail.

Minute leakages of oil and gas are believed to cause the fluorescence.

In a multiple-sand field the fluorescence intensity increases again after a decrease below each sand. Dry wells just outside fields show high values on the free fluorescence curves (free fluorescence is due to free oil and gas in samples, fixed fluorescence is that associated with the rock).

The use and features of fluorologs are described and ideal core-hole fluorolog profiles are shown.

Samples taken at 30-ft intervals are suitable, and cuttings should be taken from the mud stream. 1-oz samples are suitable. G. D. H.

Drilling.

1591. New Drilling Method. L. S. McCaslin, Jr. *Oil Gas J.*, 21.6.47, **46** (7), 108.—A description is given of a new type of drilling unit termed the Electrodrill which consists essentially of an electric motor which is geared to a circulation pump and a drill-drive shaft to which is attached a conventional type drilling bit, together with a bailer, a set of friction dogs, a junk basket and a swivel. The whole unit is lowered into the well on the power cable and is totally immersed in drilling fluid when drilling is in progress. The friction dogs bite into the sides of the hole and prevent rotation of the unit as a whole. The pump circulates fluid round the bit, which cuts in the conventional manner, whilst the fluid lifts the cuttings and dumps them in the bailer. The adaptability of this type of unit is discussed: one of the main disadvantages is the difficulty in preventing the sloughing of some formations into the hole owing to the absence of conventional mud circulation. The amount of hole that can be made without pulling the unit depends upon bit wear and the capacity of the bailer. The amount of sloughing is indicated by the amount of material in the junk basket.

A brief description is also given of a side-drilling unit, similar in operation to the Electrodrill. R. B. S.

1592. New Drilling Technique. A. Gibbon. *World Oil*, 7.7.47, **126** (6), 37.—See Abstract No. 1591 (1947).

1593. Modern Practices in Deep Contract Drilling. J. H. Abernathy. *Oil Gas J.*, 24.5.47, **46** (3), 87. (*Paper presented before Mid-Continent District, Division of Production, A.P.I., Amarillo, Texas*, Spring 1947.)—Trends in equipment developments and operating practices are discussed. The various equipment developments reviewed apply to: (1) derricks; (2) prime movers and pumps; (3) draw works; (4) transmission, compounding, and clutches; (5) drill-pipe; and (6) miscellaneous rig equipment (blocks, hooks, swivels, rotary tables, and drilling lines). The operating practices discussed are: (1) pump pressures; (2) hole size and table r.p.m.; (3) drilling weights and drilling collars; and (4) drilling mud. A summary of rig and bit performance compiled from data on several holes drilled to approximately 10,000 ft is also presented. R. B. S.

1594. Modern Rotary Drilling. Parts 21–30. J. Zaba. *Oil Gas J.*, 24.5.47, **46** (3), 111; 31.5.47, **46** (4), 271; 7.6.47, **46** (5), 99; 14.6.47, **46** (6), 129; 21.6.47, **46** (7), 117; 28.6.47, **46** (8), 147; 5.7.47, **46** (9), 103; 12.7.47, **46** (10), 103; 19.7.47, **46** (11), 95; 26.7.47, **46** (12), 289.—The sub-titles of Parts 21–30 of this series of brief articles on trends and developments in modern drilling practice are as follows: (21) Mechanical Transmission; (22) Hydraulic Transmission; (23) Hydraulic Torque Converter finds Increasing Application; (24) Electrical Power Transmission; (25) Developments in Electric Power; (26) Proper Control of Rate of Feed-off of Drilling Line; (27) Many Factors Affect Life of Wire Lines on Drilling Rigs; (28) Construction Methods of Wire Rope in Process of Evolution; (29) Deeper Drilling Resulting in Use of Heavier-Duty Wire Lines; and (30) Methods of Evaluating Service Expectancy of Wire Lines. R. B. S.

1595. Drilling Difficulties Encountered in Olive Field. T. H. Sandoz. *Oil Gas J.*, 31.5.47, **46** (4), 177.—The methods used in the Olive Field of Hardin County, Texas, in order to combat well kicking and thief formations are described. R. B. S.

1596. Giant Barge Drilling Rig. E. H. Short, Jr. *Oil Gas J.*, 31.5.47, **46** (4), 220.—A description is given of a unitized barge drilling rig in use in the Gulf Coast area. R. B. S.

1597. Directional Drilling. W. H. Cook. *Oil Gas J.*, 31.5.47, **46** (4), 232.—Recent trends in directional drilling on the Gulf Coast are briefly reviewed. R. B. S.

1598. South Texas' Deepest Test. N. Williams. *Oil Gas J.*, 7.6.47, **46** (5), 73.—A description is given of the conditions encountered in drilling the Texas Company's 16,006 ft well in Willacy County, South Texas. R. B. S.

1599. Speed, Efficiency, and Safety in West Texas Rig. G. Weber. *Oil Gas J.*, 5.7.47, **46** (9), 76.—The new features of a heavy rig recently placed in operation in the Permian Basin are described. R. B. S.

1600. Trends in Drilling Equipment and Costs. I. S. Salnikov. *Oil Gas J.*, 26.7.47, **46** (12), 220.—The trends in drilling methods and equipment, and in the costs of well drilling are discussed, and an analysis of the opinions of various contractors, etc., regarding future trends, is also presented. R. B. S.

1601. Holding Up the Offshore Drilling Rig. E. H. Short, Jr. *Oil Gas J.*, 28.6.47, **46** (8), 112.—The author discusses the various methods proposed for supporting offshore drilling rigs, as opposed to the piling platforms mainly used at the present time. The economics of offshore drilling operations are also considered. R. B. S.

1602. A.C. Auxiliaries for Diesel-Electric Drilling Rigs. J. N. Poore. *Oil Gas J.*, 12.7.47, **46** (10), 81.—The author discusses the economics and operation of both A.C. and D.C. auxiliary equipment, and suggests that there are several auxiliaries, such as blowers, pumps, and lights, which do not require the flexibility of D.C. power : in these cases some advantage may be gained by using A.C. power. R. B. S.

1603. Troublesome Drilling Problems Solved by Special Muds. G. R. Gray. *Oil Gas J.*, 31.5.47, **46** (4), 142.—The use of a specially treated starch additive for drilling in the Gulf Coast area is discussed. R. B. S.

1604. Mud Pump Piston Lubrication. Anon. *World Oil*, 7.7.47, **126** (6), 35.—The lubrication of mud pump pistons is briefly described. R. B. S.

1605. Drilling Patent. P. Marty. B.P. 590,098, 23.7.47. Boring tool holders with micrometric adjustment. G. R. N.

Production.

1606. Some Factors Affecting Success of South Texas Workovers. H. N. Lyle. *Oil Gas J.*, 31.5.47, **46** (4), 130.—The need of accurate production and geological data in planning workover jobs is emphasized. The operating and economic practicability of workover jobs is then discussed under the following headings : (1) workovers within the producing reservoir ; (2) workovers in reservoirs penetrated by the well and cased-off ; and (3) workovers in deeper reservoirs within the practicable limits of deepening operations through an oil string of casing. R. B. S.

1607. An Investigation of Errors in Bottom-Hole Pressure Measurement. H. W. Perkins and P. E. Chaney. *Oil Gas J.*, 14.6.47, **46** (6), 102.—The method of analysing data obtained by tests on bottom-hole pressure measuring instruments is described, and examples of calculations are shown. Two references are appended. R. B. S.

1608. Explosives Find Many Uses in Oil Production. M. M. Kinley and J. Kinley. *Oil Gas J.*, 7.6.47, **46** (5), 83.—The many applications of explosives in the oil producing Industry are discussed, and the following conclusions are reached : (1) most explosives must be protected from pressure since no explosive operates as well under an initial pressure ; (2) the temperatures likely to be encountered are important—spontaneous detonation temperatures vary for different explosives, whilst they become more and more sensitive to shock as their spontaneous detonation temperatures are approached ; (3) most explosives must be protected from moisture ; (4) gun perforators must be so designed and constructed that they will not burst ; (5) debris left by shooting operations must not be such as to interfere with subsequent operations in the well ; (6) attention must be paid to lowering the shot through dense and viscous mud ; and (7) attention must be paid to constrictions, etc., in the hole insofar as the maximum diameter of the shot is concerned. R. B. S.

1609. Gas Condensate Well Corrosion. T. S. Bacon. *Oil Gas J.*, 26.7.47, **46** (12), 257. (*Paper presented before National Gasoline Association of America, Dallas, Texas.*)—The research work sponsored by the National Gasoline Assoc'n of America is reviewed. Four references are appended. R. B. S.

1610. Corrosion in High-Pressure Gas Condensate Wells. T. S. Zajac. *Oil Gas J.*, 21.6.47, **46** (7), 102 ; 28.6.47, **46** (8), 127.—The causes and characteristics of corrosion in gas condensate wells are discussed in the first part, whilst the detection and prevention of corrosion are discussed in the second part.

The most likely causes of gas condensate corrosion are carbonic acids, lower fatty acids, or both. Among other factors, the velocity of flow seems to have an appreciable effect upon the rate of corrosion ; the latter increasing with rate of flow. Detection of corrosion can be accomplished by regular inspection of christmas trees, tubing caliper surveys, coupon exposures, and effluent water studies. Prevention of corrosion can be accomplished by the use of various chemical treatments and the use of corrosion-resistant materials. The present state of knowledge in these fields is reviewed and some improvements are suggested. Twenty references are appended. R. B. S.

1611. Development Programme in Brookhaven Field, Mississippi. N. Williams. *Oil Gas J.*, 14.6.47, **46** (6), 94.—Difficulties encountered in producing oil from the Brookhaven field in Lincoln County, Mississippi, and the methods used to overcome them, are outlined. R. B. S.

1612. Effect of Bacteria on Oil Production. C. J. Deegan. *Oil Gas J.*, 21.6.47, **46** (7), 78; 28.6.47, **46** (8), 101.—The author reviews the present state of knowledge regarding Dr Zobell's discovery that certain strains of bacteria seem to have the power of releasing oil from sand grains. Research work on the practical application of this discovery has been commenced by the Penn Grade Crude Oil Assoc'n, and the results of this work to date are discussed. Although no definite conclusions can yet be drawn the initial results are promising, but the need for further research is emphasized. R. B. S.

1613. Oil Production by Remote Control. W. S. Stovell, Jr. *World Oil*, 7.7.47, **126** (6), 32.—A description is given of a remote control system which has been successfully used to operate 5 producing wells in the Catahoula Lake in Louisiana. R. B. S.

1614. Pressure Maintenance Project Sets Pattern. E. H. Short, Jr. *Oil Gas J.*, 5.7.47, **46** (9), 79.—A description is given of a recently completed pressure maintenance project in Coleman County, Texas, which is characterized by automatic controls. R. B. S.

1615. Paraffin Removal. E. F. Bowers and H. Renfro. *Oil Gas J.*, 31.5.47, **46** (4), 134.—The paraffin removal practices employed in South Texas are reviewed. R. B. S.

1616. Determination of Oil and Connate Water in Place. W. A. Bruce and H. J. Welge. *Oil Gas J.*, 26.7.47, **46** (12), 223. (*Paper presented before Mid-Continent District, Division of Production, A.P.I., Amarillo, Texas*, May 1947.)—A description is given of the new "restored state" method for determining oil and connate water saturation. The technique is based on simulating the pre-production history of the reservoir by forcing oil into a water saturated core from the producing sand. The external pressure required to do this is a measure of the capillary pressure between the oil and water phases. As this external pressure, and hence the capillary pressure, is increased, the water saturation is decreased until a certain minimum value of water saturation is reached. At this point further increases in external pressure produce no further reduction in water saturation. This minimum water saturation is believed to be equivalent to connate water saturation and the physical conditions within the core at the end of the experiment are an indication of the state of the reservoir before production is commenced. The exact significance of the results obtained and the facts to be borne in mind in interpreting them are discussed.

Nine references are appended. R. B. S.

1617. Consolidation of Sands in Oil and Gas Wells. G. G. Wrightsman and H. H. Spain. *Oil Gas J.*, 19.7.47, **46** (11), 73.—A new method of consolidating loose sands around a well bore, so as to prevent material sloughing into the hole, is discussed. This new method, which involves the use of plastics, obviates the necessity of using gravel packs or liners. R. B. S.

1618. Effect of Thermal Changes on Natural Brine Densities. H. A. Hoskings. *World Oil*, 14.7.47, **126** (7), 45.—A description is given of an apparatus for determining natural brine densities at various temperatures. Some results are given of density determinations at 10°, 15°, 25°, and 35° C and a small nomograph is constructed, based upon these results, showing the temperature–density relations of various gravity brines within this temperature range. R. B. S.

1619. Haynesville Water Injection Programme Multiplies Expected Oil Recovery. G. Weber. *Oil Gas J.*, 21.6.47, **46** (7), 80.—The development and production history of the Haynesville field in Louisiana and Arkansas is outlined. The water-injection operations, which were commenced in this field in March 1946, are also described. R. B. S.

1620. Well Completion and Remedial Work with Plastics. A. A. Townsend and R. H. Smith. *Oil Gas J.*, 10.5.47, **46** (1), 76. (*Paper presented before S.W. District, Division of Production, A.P.I., Fort Worth, Texas*, March 1947.)—The use of thermosetting plastics, combined with catalysts for controlling setting time, in well completion and remedial jobs, is discussed. The dump-bailer and tubing-squeeze methods of application are also described. R. B. S.

Oilfield Development.

1621. World Crude Production Showing Very Sharp Rise. W. B. Hill. *Oil Wkly*, 10.2.47, **124** (11), 78.—During 1946 world oil output was 2,789,910,000 brl, 164,725,000 brl more than in 1945. U.S.A. produced 1,731,889,000 brl in 1946; Kuwait 6,900,000 brl, Saudi Arabia 60,500,000 brl, Venezuela 388,200,000 brl, and Mexico 49,212,000 brl. Russia's output is estimated to have been 160,000,000 brl.

Tables give the annual and average output each year from 1918, for the world, U.S.A., and the rest of the world, a comparison of pre- and post-war outputs by countries, with cumulative production to the end of 1946. A further table gives the annual output by countries from 1857. G. D. H.

1622. Major Share of Foreign Wells in Latin America. Anon. *Oil Gas J.*, 5.7.47, **46** (9), 61.—The world has about 486,543 producing oil and gas wells, of which U.S.A. has 452,000, and Latin American 19,847 wells.

A table gives data by countries on daily production, pumping and flowing wells, and rotary rigs in use. G. D. H.

1623. Increase of 50% Seen in Global Oil Output, Excluding U.S.A. W. W. Burns. *Oil Gas J.*, 26.7.47, **46** (12), 172.—An estimate of the 1947 output for the world excluding U.S.A. is 3,054,500 brl/day; the figure for 1946 was 2,764,500 brl/day. The predicted rate for 1951, again excluding U.S.A., is 4,654,500 brl/day.

It is predicted that Canada's output will be doubled by 1951. The Middle East production is expected to be more than doubled by 1951, and a six-fold rise is forecast for the Far East.

A table gives the output by countries for 1946, the estimated outputs for 1947 and 1951. G. D. H.

1624. Completions Below October Total. Anon. *Oil Wkly*, 30.12.46, **124** (5), 53.—2521 wells were completed in U.S.A. in November 1946 to give a total of 27,999 completions for the first 11 months of 1946. The November completions included 1259 oil wells, 26 distillate wells, and 286 gas wells.

A table summarizes the results of November completions by States and districts. G. D. H.

1625. December Completions Top Previous Month's. Anon. *Oil Wkly*, 27.1.47, **124** (9), 49.—2598 wells were completed in U.S.A. during December 1946 making the year's total 30,839. The 1945 total was 27,140. 15,961 oil wells, 3303 gas wells, and 207 distillate completions were made in 1946.

A table summarizes by States and districts the numbers of wells of different types completed in December, together with totals for November and December 1946 and for December 1945. G. D. H.

1626. Cessation of Warfare Fails to Halt Upward Trend in U.S.A. Crude Oil Production. Anon. *Oil Wkly*, 10.2.47, **124** (11), 84.—During 1945 U.S.A. produced 1,711,103,000 brl of oil and during 1946 1,731,889,000 brl. The weighted average price paid to producers was $1.42 in 1946, 20 cents/brl more than in 1945. Oil stocks rose during 1946. Texas gave 758,858,000 brl in 1946, surpassing the 1945 figure of 755,553,000 brl. Output in Oklahoma and California in 1946 was below the 1945 level.

Tables give U.S.A. annual and average daily outputs yearly from 1918; the December production by States in 1941, 1945, and 1946; and the annual output by States from 1859, together with the average value per brl each year. G. D. H.

1627. Few Fields Produce Big Daily Volumes. Anon. *Oil Wkly*, 10.2.47, **124** (11), 92.—At the end of 1946, 83 U.S.A. fields were producing over 10,000 brl/day. These

fields gave 2,334,674 brl/day, almost half the U.S. output at the end of the year. East Texas gave 316,000 brl/day and Wilmington 117,667 brl/day. All the fields giving over 50,000 brl/day were in Texas and California.

A table lists the fields producing over 10,000 brl/day at the end of 1946, giving the discovery year, number of wells producing, daily output per well, and daily output of the field at the end of 1946. G. D. H.

1628. Fifty-Seven Fields Have Had Big Yields. Anon. *Oil Wkly*, 10.2.47, **124** (11), 94.—57 U.S. fields have produced over 100,000,000 brl. Together they have given 15,009,625 brl out of 33,221,649,000 brl produced by the whole of U.S.A. to the end of 1946. The East Texas field has a cumulative production of 2,357,466,899 brl; Long Beach has given 721,598,105 brl.

The U.S. fields which have given over 100,000,000 brl are listed with the discovery year, 1945 and 1946 outputs, and the cumulative production to the end of 1946. G. D. H.

1629. Peak Natural Gas Output is Forerunner of Further Gain. Anon. *Oil Wkly*, 10.2.47, **124** (11), 100.—It is estimated that 4,040,000,000,000 cu. ft. of natural gas was marketed in U.S.A. in 1946 (the 1945 figure was 3,875,000,000,000 cu. ft.). U.S. gas reserves were placed at nearly 148,000,000,000,000 cu. ft. at the beginning of 1946; 78,000,000,000,000 cu. ft. is in Texas. Texas produced 1,284,000,000,000 cu. ft. in 1946.

Tables give U.S. natural gas volumes marketed each year from 1918, and the number of gas wells; the gas production by States for the first 10 months of 1946, with classification as dry gas, sour gas, and oil-well gas; the estimated proved, recoverable gas reserves by States, with a break-down into gas dissolved in oil, free gas in oil reservoirs, and gas occurring alone; the gas marketed annually since 1906 by States and its total value. G. D. H.

1630. U.S.A. Producing Oil Wells at Peak Level. Anon. *Oil Wkly*, 10.2.47, **124** (11), 106.—U.S.A. had 424,286 producing wells at the end of 1946. During the year 15,962 new oil wells were completed and 10,721 old wells were abandoned or shut in. 419,045 wells were producing at the end of 1945. The average daily output per well was 11·3 brl in 1946. 48,456 wells were flowing at the beginning of 1946, and 48,387 wells at the end of 1946. Texas had 102,759 producing wells at the end of 1946 and Pennsylvania 82,998 wells.

Mississippi has the largest average output per well, namely, 106·7 brl/day. Louisiana produced 51·6 brl/day/well, Texas 19·4 brl/day/well, and Pennsylvania 0·4 brl/day/well at the end of 1946.

Tables give the number of oil wells producing in U.S.A. at the end of 1945 and 1946, and the average daily output per well at the end of these years. G. D. H.

1631. More Drilling Forecast for 1947. Anon. *Oil Wkly*, 10.2.47, **124** (11), 112.—30,221 wells were completed in U.S.A. in 1946, and 31,048 new wells may be drilled in 1947. 4830 wildcats are indicated for 1947. 101,010,551 ft was drilled in 1946; the 1947 figure may be 106,449,000 ft.

A table gives by States the wells drilled in 1946, the wells forecast for 1947, the 1946 footage and the estimated 1947 footage. G. D. H.

1632. 1946 Completions Soar. Anon. *Oil Wkly*, 10.2.47, **124** (11), 114.—30,840 wells of all kinds were completed in U.S.A. during 1946. There were 30,221 new wells and 619 old wells deepened. Of the new wells 27,975 were drilled for oil and gas, and 2246 for salt water disposal, water or gas input. 19,472 productive wells were completed, 15,962 giving oil, 3303 gas, and 207 distillate.

Texas had 8226 new wells, Pennsylvania 4103, Oklahoma 3179, and Illinois 2342 wells. Oklahoma had a marked rise in input wells.

A table summarizes the U.S. well completions by years from 1918, giving oil, gas, distillate, water input, gas input, salt water disposal wells, and old wells deepened. A further table gives similar data by States for 1945 and 1946. G. D. H.

1633. Sharp Increase Sends Footage Drilled to Near-Record Level. Anon. *Oil Wkly*, 10.2.47, **124** (11), 118.—During 1946, 101,010,551 ft was drilled in the U.S.A., a total footage exceeded only in 1937 (104,733,341 ft). The average depth of 1946 completions was 3342 ft. Texas had 35,848,363 ft of drilling and Oklahoma 10,157,773 ft in 1946. The average depth of completions in New York was 1407 ft, in Texas 4358 ft, and in Louisiana 6174 ft.

Tables give the number of wells completed, the total footage and the average depth per well yearly for U.S.A. from 1925; the numbers of wells, total footage, and average depth of each well completed for oil, gas, distillate, and dry wells, water input, gas input, and salt water disposal wells for each State in 1946. G. D. H.

1634. Drilling and Producing Depth Marks Broken. Anon. *Oil Wkly*, 10.2.47, **124** (11), 122.—During 1946 the world's deepest well was drilled. Its depth was 16,668 ft and it lay in Kern County, California. The producing depth record was broken by a completion at 13,778 ft at Weeks Island, Louisiana.

10,000-ft wells have been drilled in 17 U.S. States, and 8 States have production below 10,000 ft. The deepest production in Missouri is at 1444 ft. Pennsylvania's deepest production is at 8625 ft.

The U.S. drilling and production depth records are listed with the depth, date, deepest formation reached, and well location. G. D. H.

1635. Smaller Firms Drilled Three-Fourths of Wells. Anon. *Oil Wkly*, 10.2.47, **124** (11), 126.—7103 wells were completed in the U.S.A. by 37 of the larger companies in 1946; these companies drilled 1029 exploratory wells. Of 4206 strict wildcats, 797 were drilled by the larger companies, and these companies had 28·2% of the discoveries. On the whole the larger companies were less active in both types of drilling than in 1945.

A table gives the total and exploratory wells completed in 1946 by each of the larger companies, with a breakdown of the exploratory wells into types of discovery. G. D. H.

1636. Fewer Rigs Running Than a Year Ago. Anon. *Oil Wkly*, 10.2.37, **124** (11), 129.—Of 4644 rigs in operation in the U.S.A. on January 1, 1947, 2951 were rotaries. Texas had 1236 rigs, including 1086 rotaries, and Oklahoma 495 rigs.

A table lists by States and districts the numbers of rotary and cable tool rigs drilling, rigged up or shut down on January 1, 1947. G. D. H.

1637. Producing Wells and Production in U.S.A. Oilfields. Anon. *Oil Wkly*, 10.2.47, **124** (11), 154.—Tabulations are given which list the fields in alphabetical order under States, with the discovery year, numbers of flowing and artificial lift wells, the 1946 output and the daily output at the end of 1946, and the cumulative output to the end of 1946. G. D. H.

1638. January Completions Slump. Anon. *Oil Wkly*, 24.2.47, **124** (13), 65.—2281 wells were completed in U.S.A. in January 1947. 1135 found oil, 21 distillate, and 281 gas.

The drilling results are summarized by States and districts, and totals are compared with those for January and December 1946. G. D. H.

1639. A.G.A. Estimates Reserves of U.S. Natural Gas. Anon. *Oil Wkly*, 17.3.47, **125** (3), 30.—Proved recoverable reserves of natural gas in the U.S.A. at the end of December 1946 were estimated to be 160,000,000,000,000 cu. ft., made up of 116,000,000,000,000 cu. ft. in gas pools, 26,000,000,000,000 cu. ft. in gas caps, and 18,000,000,000,000 cu. ft. dissolved in oil. The reserves at the end of 1945 were 148,000,000,000,000 cu. ft. At the end of 1946 the recoverable liquid in natural gas was placed at 3,321,000,000 brl, of which 1,924,000,000 brl was in gas fields, 573,000,000 brl in gas caps, and 824,000,000 brl in dissolved gas.

Tables give by States the gas reserves at the end of 1945 and 1946, with the quantities in different categories, together with figures for the recoverable reserves of liquid in natural gas. G. D. H.

1640. Completions Gain Despite Shortages. Anon. *Oil Wkly*, 31.3.47, **125** (5), 58.—2365 wells were completed in the U.S.A. in February 1947. These included 1225 oil wells, 28 distillate wells, and 286 gas wells. There were 184 service wells or old wells deepened.

A table summarizes by States and districts the results of the February completions. G. D. H.

1641. U.S.A. Production Now Exceeding that of War Peak. Anon. *Oil Gas J.*, 26.7.47, **46** (12), 174.—During the first half of 1947, the U.S.A. produced 894,776,000 brl of oil; the corresponding figure for 1946 was 848,516,000 brl and for 1945 869,802,000 brl (the previous record). The leading States in order of decreasing output are Texas, California, Louisiana, Oklahoma, Kansas, and Illinois.

The average daily output per well in the first half of 1947 was 12·4 brl.

Tables list by States the outputs of the first half of each year from 1940 to 1947, the average daily output per well and cumulative production. G. D. H.

1642. 18,000 Wells, 68 Million Feet Seen for Last Half-Year. C. J. Deegan. *Oil Gas J.*, 26.7.47, **46** (12), 176.—During the second half-year of 1947 more than 18,000 wells are expected to be drilled in the U.S.A., their footage aggregating 68,000,000 ft. More than 3000 wildcats are planned, making a total of nearly 5500 for 1947.

Tables give, by States and districts, forecasts of wells to be drilled during the second half of 1947; a comparison with drilling during the second half of 1946; drilling accomplished in the first half of 1947.

Brief notes are given on areas in which drilling activity is likely to be greatest during the second half of 1947. G. D. H.

1643. Only Steel Shortage Prevented Record-Breaking Year of Drilling. Anon. *Oil Gas J.*, 26.7.47, **46** (12), 180.—15,189 wells were completed in the U.S.A. during the first half of 1947. The average depth was 3510 ft. Shortage of steel cut down pipe for wells, and curtailed the building of pipeline outlets for production. The efficiency of drilling operations has risen since the war ended.

2399 wildcat wells were completed in the first half of 1947, 399 finding oil and 108 gas; the corresponding figures for development wells were 12,790, 7,984, and 1433 respectively. 1058 service wells were completed in the first half of 1947.

Tables summarize the well completion results by States and districts according as they are wildcats, development wells, or service wells. The fields with greatest drilling activity are listed. G. D. H.

1644. The Gulf Coast Petroleum Centre. R. J. Gonzalez. *Oil Gas J.*, 31.5.47, **46** (4), 124.—The Gulf Coast area has oil reserves estimated at 6,000,000,000 brl or over 30% of the U.S.A. reserves, and gas reserves of 60,000,000,000,000 cu. ft., which are equivalent to 10,000,000 brl of oil. There are 25,000 producing wells giving 1,275,000 brl/day. Gas-processing plants produce 82,000 brl/day. Refinery runs are 1,500,000 brl/day. Shipments total about 1,675,000 brl/day currently. The area has many deep and prolific fields. Some production is obtained from Mississippi and Florida. G. D. H.

1645. More than 500 Drilling Operations Now Under Way. N. Williams. *Oil Gas J.*, 31.5.47, **46** (4), 166.—The Gulf Coast area, some 800 miles long and 100–150 miles wide has 369 fields which, up to March 1, 1947, had produced 4,323,370,000 brl of oil. The remaining reserve is estimated at 6,000,000,000 brl. During 1946 they produced 432,733,000 brl of oil, or about 25% of the U.S. output. 7 fields have produced over 100,000,000 brl each: 11 others have exceeded 50,000,000 brl each.

207 fields in coastal Louisiana have given an aggregate cumulative production of 1,163,693,000 brl.

Active exploration on the Gulf Coast has proceeded almost uninterruptedly since 1930, when geophysics came into extensive use. Before that date 89 fields had been found: since 1930, 780 fields have been opened, 229 having been found since 1942.

On May 1, 1947 there were 510 active drilling operations representing over 300 different fields and prospects.

Tables summarize discoveries by areas and years, and give the completions by months in 1947. G. D. H.

1646. 12,000-ft Drilling. N. Williams. *Oil Gas J.*, 31.5.47, **46** (4), 214.—In the Gulf Coast area production has been found at several places below 13,000 ft. The first 12,000-ft test was drilled in 1937 and in 10 years 224 such tests have been drilled, 51 of which have exceeded 13,000 ft.

The deepest test is 16,655 ft. 6 wells produce below 13,000 ft and 8 between 12000 ft and 13,000 ft. The deepest production is at Weeks Island, Louisiana.

The 51 wells deeper than 13,000 ft are in forty-two scattered areas. These wells are listed. Tables summarize the drilling deeper than 12,000 ft according to years and depths. G. D. H.

1647. Gulf Coast's Fields Have Produced Nearly 6 Million Brl. Anon. *Oil Gas J.*, 31.5,47, **46** (4), 243.—South Louisiana has produced 1,163,693,643 brl of oil up to March 1, 1947, from 3772 wells. Comparable figures for districts 1, 2, 3, and 4, of the Texas Gulf Coast are respectively 256,853,339 brl and 3155 wells, 401,908,531 brl and 3331 wells, 2,046,733,690 brl and 8111 wells, and 693,042,099 brl and 8700 wells.

Tables list the Gulf Coast Fields with name and location, discovery year, numbers of flowing and pumping wells, daily average production, cumulative production at March 1, 1947, depth to oil sand the name of the producing formation. G. D. H.

1648. Production Almost Doubled Since 1941 in Southwestern Oklahoma. C. J. Deegan. *Oil Gas J.*, 14.6.47, **46** (6), 99.—Since 1941 southwest Oklahoma's oil output has risen from 59,000 brl/day to 116,500 brl/day. Most of the increase has come from 14 fields developed principally since 1941. The developments have been north and south of the Wichita mountains, and in association with the Arbuckles.

Tables give the production rates yearly by countries and by leading pools, and the production rates of the leading companies in 1941 and 1947. G. D. H.

1649. Crude Oil Production Sets All Time Record. Anon. *Oil Gas J.*, 23.8.47, **46** (16), 69.—U.S.A. oil output averaged 5,165,175 brl/day during the week ended August 16, 1947. G. D. H.

1650. Texas Co. Sets New World Depth Record for Producing Well—13,904 ft. Anon. *Oil Gas J.*, 30.8.47, **46** (17), 54.—1 Lafourche Basin Levee District, in the Queen Bess Island area, Jefferson Parish, Louisiana, has been completed at 13,879–13,904 ft. 40·8° oil was produced at the rate of 48 brl/day with 6,188,296 cu. ft. of gas. The flowing pressure was 4200 p.s.i. and the total depth 15,523 ft. Total drilling time was 219 days.

The static bottom-hole pressure was 6234 p.s.i. and the closed-in tubing pressure 4830 p.s.i.. The flowing bottom-hole pressure was 5685 p.s.i. for an output of 6,240,000 cu. ft/day on a ¼-in choke. The temperature at 13,877 ft was 242° F.

Some drilling and completion details are given. G. D. H.

1651. Western Canada in Midst of Major Exploration Development Programme. L. S. McCaslin. *Oil Gas J.*, 30.8.47, **46** (17), 71.—In February oil was discovered near Leduc 16 miles south of Edmonton. 788 brl/day of 36·7° crude was obtained from Devonian limestone at 5029–5066 ft. 8 producers in an area 1½ miles by 3½ miles have now been completed.

Canadian output has fallen from 10,643,000 brl in 1943, to 5,940,000 brl to date in 1947. The output is equal to about 10% of Canada's needs. Turner Valley output was 9,701,719 brl in 1942 and 5,937,362 brl in 1946.

In Colorado, Nebraska, Iowa, Wyoming, the Dakotas, and Montana the drilling of 15,600 test wells had proved 1,500,000,000 brl of oil, mainly in Montana and Wyoming. In Western Canada, which has the northern continuation of the sedimentary basin, 1600 test wells have proved about 164,000,000 brl of oil.

Leduc is the first area in the northern plains where a well has tested the Devonian. Production in East-Central Alberta was previously from the Cretaceous at depths down to about 2000 ft, except at Princess-Steveville where there is shallow Devonian production. Most production has been 14–25° A.P.I. oil.

Three horizons in the Devonian at Leduc have been labelled productive or potentially productive.

Information is given regarding the companies operating in Canada and on their activities. G. D. H.

1652. New Brunswick Field Development Planned. Anon. *Oil Gas J.*, 16.8.47, **46** (15), 61.—Stony Creek has produced a little oil and gas since 1912. In 1946 it produced 28,500 brl to give an aggregate of 390,000 brl. Gas production has averaged 650,000 M.c.f./year. 148 wells have been drilled; 87 now produce.

Plans for further development are being considered. G. D. H.

1653. First Quarter Mexican Crude Output Gains. Anon. *Oil Gas J.*, 9.8.47, **46** (14), 61.—Mexico produced 13,084,193 brl of oil in the first quarter of 1947. The corresponding figure for 1946 was 11,178,142 brl. G. D. H.

1654. Cuba 1946 Production Set at 268,000 brl. Anon. *Oil Wkly*, 17.3.47, **125** (3), 29.—Cuba produced 268,000 brl of oil, including 68,000 brl of naphtha from Motembo. Jarahueca provided the remaining oil. G. D. H.

1655. Brazil's November Output Continues to Show Decline. Anon. *Oil Wkly*, 20.1.47, **124** (8), 29.—Brazil produced 8445 brl of crude in November making 61,454 brl for the first 11 months of 1946. Candeias produced 8123 brl in November. G. D. H.

1656. Brazil Output Drops. Anon. *Oil Wkly*, 3.3.47, **125** (1), 32 (International Section).—Brazil produced 5790 brl of oil in December, making the 1946 total 67,144 brl. G. D. H.

1657. All Five Brazil Fields Show January Production. Anon. *Oil Wkly*, 24.3.47, **125** (4), 54.—Brazil produced 8798 brl of oil in January 1947, Candeias giving 7830 brl, Lobato 533 brl, Aratu 316 brl, Itaparica 111 brl, and Pitanga 8 brl. G. D. H.

1658. Bolivia Output Down. Anon. *Oil Wkly*, 24.3.47, **125** (4), 54.—Bolivia produced 346,109 brl of oil in 1946, and 406,114 brl in 1945. G. D. H.

1659. Colombia Production for December Increases. Anon. *Oil Wkly*, 3.3.47, **125** (1), 32 (International Section).—In December the Casabe field gave 361,200 brl of oil. Tropical Oil Co produced 1,122,717 brl in December, and Colombian Petroleum Co 643,845 brl. G. D. H.

1660. Modern Camps, Reservoir Control Feature Colombian Operations. K. B. Barnes. *Oil Gas J.*, 5.7.47, **46** (9), 62.—A general account is given of oil operations in Colombia. The largest and oldest operations are on the De Mares concession. The newest area is Casabe on the Yondo concession.

Production at Petrolea is mainly from fractured Cretaceous limestones, and over 27,000,000 brl has been obtained. The Tibu structure is extensive and has large closure. The Barco sand is found at 4200–5200 ft, and Lower Cretaceous production at about 10,000 ft. G. D. H.

1661. Ecuador Has Small But Lively Intergrated Petroleum Industry. K. B. Barnes. *Oil Gas J.*, 30.8.47, **46** (17), 46.—First oil production by Anglo-Ecuadorian Oilfields Ltd, in Ecuador was obtained in 1920, and by 1925 shallow production on the Santa Elena Peninsula was 350 brl/day. In 1935 the output was 2,000,000 brl from the shallow Socorro sand. Since 1935 drilling to the Atlanta sandstone at about 4200 ft has maintained production at about 2,000,000 brl/year.

A refinery was built in 1937.

Oil from seepages on the Peninsula was used many years ago. The Peninsula has sporadic outcrops of dolerite and chert in the north, and in many places the beds dip steeply. Shallow wells in the cherty masses have produced oil commercially from fissures. To the south and southeast are the Seca and Socorro shales and sandstones

of the Eocene, covered by Oligocene sands. Beneath the Socorro lies the "clay pebble bed" followed by the Atlanta sandstone.

There are about a dozen small oil pools, and some 600 shallow wells have been drilled. The Atlanta oil area shows no significant structure. Generally the sand is hard, dense, and impermeable, but in fissures and cracks over a vertical section of 1500 ft or more oil is found. Production has been found at depths ranging 2100 ft to 6200 ft.

Brief notes are given on drilling and on other aspects of the oil industry of Ecuador. G. D. H.

1662. Peru Production. Anon., *Oil Wkly*, 3.3.47, **125** (1), 26 (International Section).—During 1946 Peru produced 12,455,991 brl of oil. G. D. H.

1663. Successful Completions in Peru Show Little Change. Anon. *Oil Gas J.*, 12.7.47, **46** (10), 43.—96 oil and gas wells were completed in Peru in 1946, 40 being dry. At the end of 1946 there were 2964 producing wells. G. D. H.

1664. Peru—Oil Report. K. B. Barnes. *Oil Gas J.*, 6.9.47, **46** (18), 46.—The Zorritos, Lobitos, and La Brea-Parinas oilfields lie in northwest Peru. Zorritos is government owned and produces about 300 brl/day from 50 pumping wells, 300–1700 ft deep. About 800 wells are operating in the Lobitos and Restin–El Alto area. Production comes from depths of 3000–6300 ft in the Eocene, and averages 6200 brl/day. La Brea–Parinas yields 28,000 brl/day from Tertiary sands at depths of 1500–5000 ft. About 2100 wells are active.

6 oil producers have been completed at Agua Caliente in Eastern Peru.

There are refineries at Lobitos, Zorritos, and La Brea–Parinas, as well as near Agua Caliente.

The operations of the different companies are described. G. D. H.

1665. Venezuela Oil Production for 1946 Shows Increase. Anon. *Oil Wkly*, 24.3.47, **125** (4), 54.—Venezuela produced 388,000,000 brl of oil in 1946. 651 wells, of which 562 gave oil and 7 gas, were completed in that year. G. D. H.

1666. Venezuelan Production Shows Decline in April. Anon. *Oil Gas J.*, 5.7.47, **46** (9), 61.—In March 1,159,763 brl/day of oil was produced in Venezuela and in April 1,143,950 brl/day. Over a quarter of the output came from Lagunillas. G. D. H.

1667. Decline Indicated for High Venezuelan Output Rate. Anon. *Oil Gas J.*, 12.7.47, **46** (10), 46.—During the first 4 months of 1947 Venezuela's output was 13·8% higher than for the same period of 1946. Daily output during the first 3 weeks of May averaged 1,107,016 brl/day. G. D. H.

1668. Venezuelan Daily Production Shows Decline in May. Anon. *Oil Gas J.*, 26.7.47, **46** (12), 159.—The daily production in Venezuela averaged 1,143,333 brl/day in April and 1,127,992 brl/day in May. G. D. H.

1669. Mata Grande Production in Venezuelan Extended. Anon. *Oil Gas J.*, 2.8.47, **46** (13), 43.—10 oil wells and a gas well now produce on the Mata Grande concession in eastern Venezuela. No. 16, the latest well, gave on test 300 brl/day of 33-gravity oil with G.O.R. of 400, from 4760 ft. The choke was $\frac{7}{32}$-in. G. D. H.

1670. Maracaibo and Adjoining Areas World's Largest Producing Refining Concentration. K. B. Barnes. *Oil Gas J.*, 2.8.47, **46** (13), 44.—The Bolivar coastal fields extend for about 50 miles along the eastern edge of the Lake, and produce 609,000 brl/day from 3092 wells. Other pools lie to the west, northeast, and southwest. La Paz has seven Cretaceous wells in addition to old, shallow Eocene wells. Mara has three Cretaceous wells.

Two refineries are being built, and two small refineries are built. Large refineries exist on Curacao and Aruba.

Wells have been drilled in 100 ft of water 10 miles out in the lake. G. D. H.

1671. Eastern Venezuela—Status Report on Operations. K. B. Barnes. *Oil Gas J.*, 23.8.47, **46** (16), 62.—Production in eastern Venezuela is mainly from Miocene sands. Multiple pay sands occur. The topography and history of oil developments in this area are described.

Currently eastern Venezuela produces 345,000 brl/day from about 1400 wells, most of which flow. Gas drive seems to be the dominant producing mechanism. Pressure maintenance is carried out in some fields. An experimental water-flood has been tried in the "B" segment of the L_1 sand at Oficina. There is a description of some recent plant installations. G. D. H.

1672. Dutch Field Producing 2100 Brl Oil Daily. Anon. *Oil Wkly*, 23.12.46, **124** (4), 30.—Coevorden is now producing 2100 brl/day from the Lower Cretaceous at 2500–2700 ft. 15 producing wells have been drilled in an area of 1900 acres. The structure is anticlinal and probably associated with a salt intrusion. The name has been officially changed to Schoonebeek. G. D. H.

1673. German Oil Output. Anon. *Oil Wkly*, 17.2.47, **124** (12), 16.—During the first 8 months of 1946 the oil production of the British zone in Germany was about 3,099,608 brl. G. D. H.

1674. Five Tests Started in British Zone of Germany. Anon. *Oil Gas J.*, 19.7.47, **46** (11), 45.—Five tests are now under way in the Zwischenahner district of Oldenburg.

The production of the British zone is about 12,600 brl/day and in 1946 the U.S. zone gave about 95 brl/day. G. D. H.

1675. Soviets Emba Area Shows Increase in 1946 Over Pre-War. Anon. *Oil Wkly*, 10.3.47, **125** (2), 39.—The Emba area produced 5,600,000 brl of oil in 1946. The pre-war annual output was 4,550,000 brl. Proved reserves are 280,000,000 brl, and production is expected to be 8,400,000 brl in 1950. Most production comes from the Jurassic, but the Cretaceous and Triassic also produce. Most fields are associated with salt intrusions, giving flank and cap oil. Dossor, Makat, Baitchunas, Iskin, Koschagil, and Schubarkuduk are the main fields. G. D. H.

1676. Russia's Production : Argentina Plans Gas Line. Anon. *Oil Wkly*, 24.3.47, **125** (4), 54.—Russia produced about 166,827,000 brl of oil in 1946. Argentina plans to build a gas pipeline from Comodoro Rivadavia to Buenos Aires. G. D. H.

1677. A.I.O.C. Figures Show 1946 Output at 19,189,551 Tons. Anon. *Oil Gas J.*, 19.7.47, **46** (11), 44.—During 1946, Iran production was 19,189,551 tons (the 1945 figure was 16,839,490 tons). 4,448,000 tons was produced in the first quarter of 1947.

The U.K. production was 55,387 tons in 1946 and 71,542 tons in 1945.

G. D. H.

1678. Anglo-Iranian Production Shows Sharp Increase. Anon. *Oil Gas J.*, 2.8.47, **46** (13), 43.—During April the Iran production averaged 411,933 brl/day.

G. D. H.

1679. Haft Kel Leads Anglo-Iranian Production. *Anon.* *Oil Gas J.*, 16.8.47, **46** (15), 61.—Iran production in 1946 was Haft Kel 8,750,448 tons, Agha Jari 4,065,739 tons, Masjid-i-Suliaman 3,674,797 tons, Gach Saran 1,879,096 tons, White Oil Springs 699,389 tons, Naft-i-shah 92,713 tons, and Pazanum 27,370 tons. G. D. H.

1680. A.I.O.C.'s May Output at 378,800 brl Daily. Anon. *Oil Gas J.*, 6.9.47, **46** (18), 45.—During May, Iran oil output was 1,525,000 tons, giving a total of 7,587,000 tons this year. G. D. H.

1681. Japanese Oil Production Reported Falling Behind. Anon. *Oil Wkly*, 20.1.47, **124** (8), 29.—In August 1946 Japanese oil production was 131,522 brl. A strike caused a drop to 98,539 brl in September. 708,175 brl were produced in the first half of 1946. G. D. H.

1682. 10 Million Brl for Nederlands East Indies. Anon. *Oil Wkly*, 3.3.47, 125 (1), 26 (International Section).—1946 oil production in the Dutch East Indies is estimated to have been about 1,300,000 metric tons.

British Borneo gave 35,009,000 brl. Tarakan is producing about 4000 brl/day.

G. D. H.

TRANSPORT AND STORAGE.

1683. Corrosion of Buried Pipes. Anon. *Petroleum*, June 1947, 10, 133.—It is now well established that corrosion of a ferrous metal immersed in water occurs by an electrochemical mechanism. On a non-uniform surface, polarization by hydrogen of the tiny galvanic cells set up inhibits further corrosion. If, however, oxygen is available to act as a depolarizer, corrosion will continue.

Certain agents can depolarize anaerobically, among them being sulphate-reducing bacteria of which *Vibrio desulphuricans* is an example. This is a facultative autotroph and not a strict anaerobe and it has been found that iron is essential to growth.

An iron pipe buried in the subsoil under anaerobic conditions, *e.g.*, in heavy clay, will corrode if sulphate and this particular *Vibrio* are present, and this has been paralleled in controlled laboratory experiments.

A general theory of the reactions is advanced, but all parts of the hypothesis have not yet been tested.

F. W. H. M.

REFINERY OPERATIONS.

Refineries and Auxiliary Refinery Plant.

1684. Priming Centrifugal Pumps. Refiner's Notebook No. 156. W. L. Nelson. *Oil Gas J.*, 9.8.47, 46 (14), 111.—Brief notes are given in connexion with the functioning of refinery centrifugal pumps. The notes cover: the necessity of venting, whether or not pumps are installed with a positive or "flooded" suction head; the use of steam (air or water) evacuators and foot valves, and their application. Evacuators and foot valves are seldom used on refineries for the reasons given. Refineries generally use a positive suction head, but so-called priming tanks are also used. A simple priming tank application is illustrated and its functioning described. The maximum suction lifts of pumps and method of computing it are described in the *Refiner's Notebook* No. 155 of 2.8.47.

W. H. C.

1685. Vacuum and Close-Clearance Pumps. W. L. Nelson. *Oil Gas J.*, 30.8.47, 46 (17), 103.—No. 159 in the *Refiner's Notebook* Series gives conditions for the optimum operation of vacuum and close-clearance pumps. Loss of suction due to vapour locking whilst handling a hot liquid is discussed and illustrated.

It is possible to operate with a positive suction head of only 4 ft when pumping 700° F boiling liquid with even 40% of fuller's earth at a pressure of 1-in of mercury in the suction vessel, but heads of 8 ft or more are recommended.

Reference is also made to *Refiner's Notebook* No. 155.

G. A. C.

1686. Thermal Cracker Expanded into T.C.C. Unit at Leonard Refineries, Inc. A. L. Foster. *Oil Gas J.*, 16.8.47, 46 (15), 78–82.—Exceptional interest has been directed to the functioning of the new thermofor catalytic cracking plant at Leonard Refineries, Inc., Alma, Michigan, owing to its being the first post-war small-scale unit and also on account of its development from a conventional thermal unit. A photograph, a flow sheet, and drawings, including three of special features, are given, and the installation is described. Some of the old equipment used, the 2 Unaflow coil heaters (ex Dubbs), the tar separating tower (Dubbs Flash Chamber), the synthetic crude tower, absorber and stabilizing columns, compressor, etc., have been slightly modified. The new equipment consists of the following: A top-suspended elevator, 153 by 6 ft in which the conveyor buckets have three compartments, the outside ones taking the spent catalyst to the regenerator hopper, the inner taking the regenerated catalyst to the reactor hopper. The buckets are fed respectively by a Y divided chute and a single chute, and are emptied by inversion at the top into similar chutes leading to

their respective hoppers. The reactor is situated in a 12 ft dia column which contains three sections: (*a*) the hopper which feeds the reactor via a 49 ft by 11 in line through the second section, (*b*) which is the hot catalyst storage vessel, (*c*) the reactor is the lowest section. The catalyst distributor and a unique indicating level controller at the top of the reactor, and the catalyst and vapour separator at the bottom are described. The means provided for preventing the vapour passing into the hopper and to the regenerator at the bottom, are by inert gas at about 10 in water pressure above the reactor pressure (6–8 p.s.i.) and purge steam, respectively. The regenerating system comprises a kiln, 10½ ft by 58 ft, a flue gas stack, air-line burner, blower, and auxiliaries. The kiln is fed by a hopper through a distributor, and contains seven regenerating zones, each with cooling coils, air inlet channels near the vertical centres of the zone, and alternating with the air inlets are flue gas or collector channels leading to the stack. Lines from the elevator top and flue-gas stack lead to an elutriator and cyclone for the elimination of fines, and a line from the regenerator cooling coils passes through a cooling water system and provides steam. The constructional materials employed are discussed and typical operating details are given of running two Michigan reduced crudes. Several economies attained by the design are described; a further economy was made by providing a simple barometric condenser, or direct water-contact unit instead of a conventional shell and tube exchanger, for condensing the overhead from the synthetic crude main fractionator. The plant was designed for 3000 brl/day, and has accomplished 5000 brl/day with good yields, and still promises more. The total overall cost was $250 brl/day throughput capacity. W. H. C.

Chemical and Physical Refining.

1687. Silicone Anti-Foam Agents for Lubricating Oils. Anon. *Petroleum*, June 1947, **10**, 132.—The use of very low concentrations of certain organic compounds of silicon, particularly those in which the carbon atoms are directly linked, are claimed to be extremely effective in suppressing the foaming characteristics of lubricating oils, without adversely affecting the other functional properties of the oil. Data is given to support these claims. F. W. H. M.

Special Processes.

1688. Benzonitrile Produced on Semi-Commercial Basis. Anon. *Oil Gas J.*, 9.8.47, **46** (14), 116.—A pilot plant has been erected at the Socony-Vacuum's Paulsboro refinery, New Jersey, U.S.A., for the production of benzonitrile from toluene and ammonia. These, in the presence of a catalyst, whose nature is not disclosed, react as follows: $C_6H_5CH_3 + NH_3 \rightarrow C_6H_5{\cdot}CN + 3H_2$. Benzonitrile has an especially high reactivity with a large number of chemicals which can be used for the synthesis of rubber, resins, plastics, pharmaceutical products, etc. Its application in these fields has so far been handicapped by the lack of adequate quantities. W. H. C.

Refining Patents.

1689. Patents on Refining Processes and Products. C. Arnold (Standard Oil Dev. Co.). B.P. 589,861, 16.7.47. Polymerization of olefins.

Standard Oil Dev. Co. and J. C. Arnold. B.P. 589,868, 16.7.47. Gelatinous hydrocarbon conversion catalysts.

Shell Development Co. B.P. 589,915, 16.7.47. Production of mono-olefins from more highly unsaturated hydrocarbons.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 589,879, 16.7.47. Catalytic conversion of hydrocarbon oils.

Du Pont de Nemours and Co. and W. E. Hanford. B.P. 589,923, 16.7.47. Lub. compositions.

C. Arnold (Standard Oil Dev. Co.). B.P. 589,847, 16.7.47. Catalytic cracking.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 590,007, 16.7.47. Reactions in the presence of contact particles.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 590,192, 23.7.47. Low temperature polymers of olefins.

A. Abbey (Biggs Clarifier Co.). B.P. 590,214, 23.7.47. Dehydrating lub. oil.

C. Arnold (Standard Oil Dev. Co.). B.P. 590,106, 23.7.47. Manufacture of stable distillate fuel oils.

C. Arnold (Standard Oil Dev. Co.). B.P. 590,252, 23.7.47. Manufacture of spherical particles.

Standard Oil Dev. Co. and C. Arnold. B.P. 590,311, 23.7.47. Dehydration of ethyl alcohol.

Standard Oil Dev. Co. B.P. 590,455, 30.7.47. Isomerization of *n*-paraffins.

Standard Oil Dev. Co. B.P. 590,456, 30.7.47. Catalytic conversion.

Shell Dev. Co. B.P. 590,368, 30.7.47. Insecticidal and fungicidal compositions.

C. Arnold (Standard Oil Dev. Co.). B.P. 590,336, 30.7.47. Control of heat exchange between fluids.

Shell Dev. Co. B.P. 590,479, 30.7.47. Production of olefin oxides.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 590,338, 30.7.47. Catalytic conversion.

Universal Oil Products Co. B.P. 590,488, 30.7.47. Isomerization of liquid paraffins.

Shell Dev. Co. B.P. 590,490, 30.7.47. Production of alkyd resins.

Standard Oil Dev. Co. B.P. 590,492, 30.7.47. Production of alkylated aromatic hydrocarbons.

Du Pont de Nemours and Co. B.P. 590,381, 30.7.47. Catalyst compositions.

B. Hayter and J. L. Breese (Oil Devices). B.P. 590,531, 30.7.47. Liquid fuel burners.

Socony-Vacuum Oil Co., Inc. B.P. 590,425, 30.7.47. Continuous cyclic system for catalytic reactions.

Low Temperature Carbonization, Ltd., G. S. Pound, and S. R. M. Ellis. B.P. 590,635, 7.8.47. Refining of oils.

Standard Oil Dev. Co. B.P. 590,548, 7.8.47. Production of xylene.

Lummus Co. B.P. 590,590, 7.8.47. Styrene fractionation.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 590,595, 7.8.47. Polymerization of *iso*-olefins.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 590,597, 7.8.47. Separation of finely divided solids from gases by treatment with liquids.

Anglo-Iranian Oil Co. Ltd. (R. W. King). B.P. 590,554, 7.8.47. Counter-current treatment in two-phase fluid systems.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 590,613, 7.8.47. Production and separation of *tert.*-olefins.

C. Arnold (Standard Oil Dev. Co.). B.P. 590,616, 7.8.47. Polymerization of olefins.

Du Pont de Nemours and Co., C. H. Hamblit, and A. McAlevy. B.P. 590,571, 7.8.47. Reacting olefins with formaldehyde.

Standard Oil Dev. Co. B.P. 590,882, 13.8.47. Contacting finely divided solids and gaseous fluids.

J. W. Williams. B.P. 590,940, 13.8.47. Purification of contaminated machine oils.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 590,885, 13.8.47. Addition agents for petroleum oils.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 590,904, 13.8.47. Separation of powdered material from gases.

A. L. Mond (Universal Oil Products Co.). B.P. 590,905, 13.8.47. Separation of gaseous mixtures.

Du Pont de Nemours and Co. B.P. 590,816, 13.8.47. Ethylene polymers.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 590,868, 13.8.47. Stripping volatile material from solid particles.

F. J. Cleveland (Socony-Vacuum Oil Co., Inc.). B.P. 590,973, 13.8.47. Lub. oil compositions containing stabilizers.

Shell Dev. Co. B.P. 590,980, 13.8.47. Production and recovery of hydroaromatic *cyclo*paraffins.

Standard Oil Dev. Co. B.P. 590,994, 20.8.47. Lubricating greases.

Standard Oil Dev. Co. B.P. 591,101, 20.8.47. Operation of supercharged aviation engines.

C. Arnold (Standard Oil Dev. Co.). B.P. 591,137, 20.8.47. Interpolymers of rubber-like structure.

Shell Dev. Co. B.P. 591,078, 20.8.47. Production and recovery of hydroaromatic *cyclo*paraffins.

Shell Dev. Co. B.P. 591,037, 20.8.47. Application of finely divided contact materials.

Standard Oil Dev. Co. B.P. 591,399, 27.8.47. E.P. lubricants.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 591,358, 27.8.47. Separation and purification of alkyl halides.

J. G. Gaunt (Girdler Corpn.). B.P. 591,406, 27.8.47. Alkylation of *iso*paraffins with olefins in the liquid phase.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 591,417, 27.8.47. Hydrocarbon conversion.

C. Arnold (Standard Oil Dev. Co.). B.P. 591,248, 27.8.47. Production of triisobutylene.

Shell Dev. Co. B.P. 591,373, 27.8.47. Catalytic cracking.

Du Pont de Nemours and Co. B.P. 591,335, 27.8.47. Ethylene polymerization.

W. W. Triggs (N.V.I.H.M.). B.P. 591,347, 27.8.47. Desulphurization of petroleum distillates.

Shell Dev. Co. B.P. 591,348, 27.8.47. Piston assembly.

Standard Oil Dev. Co. B.P. 591,444, 3.9.47. Curing polymeric materials.

Shell Dev. Co. B.P. 591,543, 3.9.47. Production of ditertiary peroxides.

Universal Oil Products Co. B.P. 591,631, 3.9.47. Alkylation process.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 591,544, 3.9.47. Alkylation process.

Gulf Research and Dev. Co. B.P. 591,547, 3.9.47. Dealkylation of alkylphenols.

Akt. Separator-Nobel. B.P. 591,621, 3.9.47. Production of oils of low pour-point and mineral waxes of different melting points.

Lummus Co. B.P. 591,983, 17.9.47. Azeotropic distillation.

I.C.I. Ltd. B.P. 591,984, 17.9.47. Fuel containers.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 591,989, 17.9.47. Synthesis of gasoline.

C. Arnold (Standard Oil Dev. Co.). B.P. 591,903, 17.9.47. Silica gel catalysts.

Universal Oil Products Co. B.P. 592,088, 17.9.47. Conversion of gaseous olefins.

J. C. Arnold (Standard Oil Dev. Co.). B.P. 591,912, 17.9.47. Spherical form of alumina gel.

Shell Dev. Co. B.P. 591,915, 17.9.47. Coating compositions.

Shell Dev. Co. B.P. 592,116, 17.9.47. Preparation of stabilized alumina.

J. R. Bates and H. A. Shabaker, assrs to Houdry Process Corpn. U.S.P. 2,412,958, 24.12.46. Manufacture of a contact material from an inorganic gel.

E. Hene. U.S.P. 2,412,983, 24.12.46. Conversion of heavy hydrocarbons by passage over a molten surface.

G. B. Hatch, E. F. Pevere, L. A. Clarke, and F. H. Bruner, assrs to The Texas Co. U.S.P. 2,413,105, 24.12.46. An alkylation process.

R. A. Swenson, assr to Standard Oil Co., Indiana. U.S.P. 2,413,121–2, 24.12.46. Manufacture of mill greases.

J. M. Musselman and H. P. Lankelma, assrs to Standard Oil Co., Ohio. U.S.P. 2,413,188, 24.12.46. A salt of an organic oxysulphur acid is used as a lub. oil additive.

R. C. Taylor, assr to The Atlantic Refining Co. U.S.P. 2,413,199, 24.12.46. Manufacture of aliphatic hydrocarbon sulphonates.

J. C. Ward, Jr. and J. J. Sims, assrs to Phillips Petroleum Co. U.S.P. 2,413,205, 24.12.46. Ethylene glycol is used in the concentration by distillation of an aqueous solution of a hydrogen halide.

H. C. Reed and B. M. Holt, assrs to Union Oil Co. U.S.P. 2,413,245, 24.12.46. Azeotropic distillation of toluene.

R. I. Stirton, assr to Union Oil Co. U.S.P. 2,413,262, 24.12.46. An aviation gasoline which contains an amine, aromatic, and other hydrocarbons and lead tetraethyl.

H. R. Warrick, assr to The Texas Co. U.S.P. 2,413,271, 24.12.46. A catalytic cracking process.

H. S. Bloch, assr to Universal Oil Products Co. U.S.P. 2,413,310, 31.12.46. Recovery of hydrocarbons from aluminium chloride sludge.

C. A. Cohen, assr to Standard Oil Dev. Co. U.S.P. 2,413,311, 31.12.46. Removal of pepper sludge and SO_2 from an acid treated lub. oil by means of a filter aid followed by the formation of oil soluble sulphonates in the oil by the addition of a basic compound of a polyvalent metal.

R. M. Cole, assr to Shell Dev. Co. U.S.P. 2,413,312, 31.12.46. Desulphurization of a cracked gasoline in stages using hydrogen and a suitable catalyst.

J. M. Musselman, assr to Standard Oil Co., Ohio. U.S.P. 2,413,332, 31.12.46. The reaction product of a phosphorus sulphide and an oxygen containing wax is used as a lub. oil additive.

B. F. Hunter and H. P. Hobart, assrs to Gulf Oil Corpn. U.S.P. 2,413,353, 31.12.46. A cutting oil composition which contains a solvent extract.

L. Schmerling, assr to Universal Oil Products Co. U.S.P. 2,413,384, 31.12.46. Catalytic production of branched chain paraffins from an alkyl halide and *iso*paraffins.

H. Dreyfus, U.S.P. 2,413,407, 31.12.46. Cracking hydrocarbons in the presence of a diluent gas.

B. T. Anderson and M. T. Flaxman, assrs to Union Oil Co. U.S.P. 2,413,482, 31.12.46. A petroleum extract containing phenol homologues and naphthenic acids is added to a highly refined diesel fuel to enhance its lubricating quality.

D. L. V. Katz, assr to Phillips Petroleum Co. U.S.P. 2,413,503, 31.12.46. A high pressure absorption process for extracting gasoline from gas ex condensate wells.

G. R. N.

PRODUCTS.

Chemistry and Physics.

1690. Anaerobic Fermentation of Alkali-Metal Oleates; Production of Petroleum. J. Laigret. *Compt. Rend.*, 1947, **225**, 398-399.—In previous work the author had shown that a particular strain, A.5029 of *B. perfringens* formed large amounts of methane when grown in media containing alkali-metal formates. The same organism grown in a medium containing commercial-grade olive-oil soap produces carbon dioxide and a black combustible liquid which accumulates on the surface of the medium. Distillation of this gives a 15% fraction (163° initial b.p. to 300°), a 50% fraction (boiling range 300-350°), and 35% residual black tar which does not distil

at 350° at atmospheric pressure. The fermentation process has been maintained continuously in 1-litre flasks, each yielding 3 g of crude liquid product per day from 4 g of soap.

The results indicate that petroleum is the product of a bacterial fermentation and that the geological process can be reproduced in the laboratory. The enzymes involved are produced by the anaerobic bacterium previously recognized as a powerful methane producer, but it is evident that it is also capable of synthesizing liquid petroleum hydrocarbons. G. H. B.

1691. Structure of Ethylene Oxide and *cyclo*Propane. J. W. Linnett. *Nature*, 1947, **160** (4057), 162.—Calculations of the force constants of ethylene oxide and *cyclo*propane from the Raman spectra and infra-red spectra indicate that the CH-links in these compounds approach those in ethylene, thus providing support for Walsh's formulæ (see Abstract No. 617 (1947)). H. C. E.

1692. Formulæ for Ethylene Oxide and *cyclo*Propane. R. Robinson. *Nature*, 1947, **160** (4057), 162.—Robinson's objections (Abstract No. 878 (1947)) to Walsh's formulæ (Abstract No. 617 (1947)) are based upon the symbols used. Argument is also directed against the similarity of reactions of ethylene oxide with those of ethylene. H. C. E.

1693. Notes on Rate Process Theory of Flow. A. Bondi. *J. Chem. Phys.*, 1946, **14**, 591.—For the purpose of predicting viscosity of liquids from first principles, the paper deals with the separation of the contributing terms of the energy and entropy of activation for viscous flow, and with the identification of some of the molecular constants which enter into these terms. J. T.

1694. Infra-Red Absorption Spectra of Some C_4 and C_5 Dienes. R. S. Rasmussen and R. R. Brattain. *J. Chem. Phys.*, 1947, **15**, 131.—The infra-red absorption spectra in the interval from 2 to 15 μ are given for 1 : 3-butadiene, 1 : 2-butadiene, isoprene and *cis-* and *trans*-1 : 3-pentadiene vapours. General features of these spectra are discussed. J. T.

1695. Infra-Red Absorption Spectra of Some Octenes. R. S. Rasmussen, R. R. Brattain, and P. S. Zucco. *J. Chem. Phys.*, 1947, **15**, 135.—The infra-red absorption spectra in the interval from 2 to 15 μ are given for 1-octene, 2-octene, 3-octene, 4-octene, 2-methyl-1-heptene, 6-methyl-1-heptene, and 2 : 2 : 4-trimethyl-1-pentene. General features of these spectra are discussed. J. T.

1696. Motions of Molecules in Condensed Systems. III. The Infra-Red Spectra for *cyclo*Hexane Solid II, Solid I, Liquid and Vapour in the Range 3 to 15 μ. G. B. Carpenter and R. S. Halford. *J. Chem. Phys.*, 1947, **15**, 99.—Comparison is made of the infra-red absorption spectra for the same amount of *cyclo*hexane vapour at 20° C, liquid at 10° C, and solid I at 3° C for the interval from 650 to 3300 wave numbers, also when it exists as solid I at − 75° C and solid II at − 110° C for the intervals 700 to 1600 and 2500 to 3300 wave numbers. The four spectra are quite similar and only slightly differ from that of the vapour. The results are in contrast with those reported for benzene and indicate that there is a greater semblance of order in liquid *cyclo*hexane than in liquid benzene. J. T.

1697. The Mercury Photosensitized Reactions of 1-Butene and 2-Butene. H. E. Gunning and E. W. R. Steacie. *J. Chem. Phys.*, 1946, **14**, 581.—The products of the reactions of 1-butene with mercury ($^3P_1$) atoms at 30° C are 2-butene and liquid polymer. Other products particularly at low pressures are also formed. In the region of complete quenching the rate of isomerization increases rapidly with pressure while that of polymerization decreases. 2-Butene is less reactive than 1-butene; the product of the reaction being a liquid polymer with smaller amounts of hydrogen and methane. An activated molecule mechanism is suggested to account for the essential aspects of the reaction. J. T.

1698. The Mercury Photosensitised Reactions of *iso*Butene. H. E. Gunning and E. W. R. Steacie. *J. Chem. Phys.*, 1946, **14**, 544.—The products of the reaction of *iso*butene with mercury ($^3P_1$) atoms at 30° C are propylene, liquid polymer, and acetylene together with a large number of other products which exist in smaller amounts. In the region of complete quenching the rates of formation of propylene, acetylene, and propane and also the overall rate of consumption of *iso*butene are independent of pressure, and the rate of formation of propylene is double that of acetylene. A mechanism is proposed for the reaction. The average molecular weight of the polymer is suggested to be approximately 240. J. T.

1699. Solubility of Paraffin-Chain Compounds. A. Bondi. *J. Phys. and Colloid Chem.*, 1947, **51**, 891.—The data recently published on solubilities of paraffin-chain compounds are subjected to analysis for deviation from Raoult's law and such deviations are expressed as excess free energy of mixing ΔF_M. From plots of ΔF_M against concentration the relationship between chemical constitution of the solute and its solubility as well as the specific interactions between the solute and the solvent are discussed in detail.

By the application of Guggenheim's solubility theory, the molecule-size differences between solute and solvent in long chain paraffin hydrocarbon in carbon tetrachloride and *cyclo*hexane systems may account for their negative deviation from Raoult's law. The positive deviation from Raoult's law of most paraffin chain compounds in the common solvents can be due to differences in cohesive energy density and to considerable excess entropy of mixing, ΔS_M. Some values of ΔS_M for systems containing alcohols are estimated and the solubility of fatty acids in water is discussed. J. T.

1700. Refractive Indices of Soaps and Detergents. H. B. Klevens. *J. Chem. Phys.*, 1946, **14**, 567.—The variation in the refractive indices with concentration for various soaps may be characterized by an intersection of two linear functions. This intersection is believed to represent the critical micelle concentration above which micelles are formed. The results of experiments on laurylamine hydrochloride and potassium laurate are reported. J. T.

1701. Effect of Temperature on Mass Spectra of Hydrocarbons. R. E. Fox and J. A. Hipple. *J. Chem. Phys.*, 1947, **15**, 208.—A description of the ion source for studying the effect of temperature on the mass spectra of hydrocarbons is given. Mixtures of *iso*butane and neon were used and the intensities of various ions in *iso*butane relative to Ne^{20+} were measured at various temperatures. The ion $C_4H_{10}^+$ is about twice as abundant at 70° C as the $C_4H_9^+$ ion becoming equal to it at 180° C and less abundant at higher temperatures. The ratio of these two peaks may be used as a means of measuring the temperature of the source. A similar temperature dependence is detected in the mass 58 peak of *n*-butane. Other hydrocarbons show even greater temperature dependence. J. T.

1702. Spectrophotometric Studies on Solubilization of Hydrocarbons. W. Heller and H. B. Klevens. *J. Chem. Phys.*, 1946, **14**, 567.—An emulsion which is strongly light scattering is formed when the limiting concentration of a hydrocarbon, C_1, which defines its solubility in a soap is exceeded. C_1 is characterized by a minimum in light scattering which is caused by a decrease in size of the molecular aggregates of soap with increasing oil concentrations greater than C_1. Solubilization studies on ethylbenzene at 20–25° C have shown that C_1 increases with time especially in concentrated solutions and that the number of moles of ethylbenzene dissolved per mole of soap. R_M increases for a given soap concentration with increasing chain length of the molecules. Furthermore, with an increase in the concentration of a given soap, R_M first decreases and after reaching a minimum increases almost linearly without any indication of approaching saturation at a 15% concentration. From the concepts of lamellar micelle-structure and using cross-sectional areas of soap molecules obtained from X-ray measurements one can finally calculate from corrected values of R_M, the thickness (spacing) of the individual ethylbenzene layers. J. T.

1703. Surface Tension in Liquids. C. Gurney. *Nature*, 1947, **160** (4057), 166.—The tensile stress in the free surface of a liquid is explained in terms of Gibbs' "intrinsic

potential" which is a measure of the escaping tendency of molecules. By analogy with a pure solid in equilibrium with its liquid, it is shown that a tension in the plane of the surface must be applied to maintain equilibrium between the molecules in the surface of a liquid and those in the interior. The tension in the surface reduces the intrinsic potential of the surface because of the work done against the tension when a molecule escapes from the surface. Therefore a state of dynamic equilibrium exists, in which molecules entering and leaving the surface do so in numbers which keep the intrinsic potentials of the surface and the bulk liquid equal. H. C. E.

1704. Ultrasonic Propagation in Liquids. 1. Application of Pulse Technique to Velocity and Absorption Measurements at 15 Megacycles. J. R. Pellam and J. K. Galt. *J. Chem. Phys.*, 1946, **14**, 608.—Description of an apparatus is given which generates pulses of 1 microsecond duration at 15 mc/sec and picks up the resultant echo from a plane reflector. Measurements of sound velocity and absorption are reported for a number of homologous series of organic liquids, including some alkyl halides, benzene, and paraffins. J. T.

Analysis and Testing.

1705. Copper-Strip Corrosion Tests. J. A. Bolt. *Oil Gas J.*, 9.8.47, **46** (14), 99.—Brief details are given of the Philadelphia and three A.S.T.M. copper strip test methods, and their import and the causes of corrosion are discussed. Tests on various refinery products show that copper strip corrosion manifests itself in a series of distinctive colours. A summary is given of the work so far carried out to develop corrosion standards, and a tentative set of copper standards is given in a table showing corrosion numbers (1–12) and descriptive terms for them. Further work to be undertaken to establish permanent standards, in which the colour of the strip is also a function of the corrosive sulphur present in the sample, is outlined. The requirements in materials, *e.g.*, a corrosive sulphur compound and a non-corrosive diluent suitable for making the standard strips, are discussed. Elemental sulphur or a brand product such as sulphurized pentane (Ortholeum 202 made by Du Pont de Nemours and Co.), appear promising for the purpose. For the non-corrosive diluent; pure *n*-heptene and cetane seem suitable. The preparation and preservation of the copper strip standards are discussed. W. H. C.

1706. Engine Testing of Fuels and Lubricants. 4. Lubricants—General Observations (Part 1). P. H. Moore. *Petroleum*, June 1947, **10**, 129.—A detailed discussion on the selection of test engines to evaluate lubricant quality is given. There are two methods of obtaining a suitable power unit. Either a commercial unit can be modified to obtain the necessary control of operating conditions, or a special engine can be built. Of the points discussed regarding test-engine requirements, that of ensuring accurate methods of governing the engine temperature is stressed. Details as to how this can be accomplished are given.

A table showing the uses claimed for five of the most popular special test engines used in the United States is given. The engines are (1) Caterpillar (single-cyl, 4-stroke, diesel); (2) Caterpillar (4-cyl, 4-stroke, diesel); (3) Chevrolet (6-cyl, 4-stroke, petrol); (4) General Motors, Series 71 (2-stroke, 3- or 4-cyl, diesel); and (5) Lauson (single-cyl, 4-stroke, petrol).

The main features of the Lauson engine are given and also its performance curves. It does not replace the more elaborate tests on Caterpillar or Chevrolet engines, but is used as a rough screen for oils to be further tested. F. W. H. M.

1707. Infra-Red Absorption Analysis of Gases and Vapours (3). 3. Commercial Instruments. R. Quarendon. *Petroleum*, May 1947, **10**, 106.—In this third article dual-path analysers are discussed and commercial instruments described.

Dual-path analysers have in recent years been used as a means of overcoming obstacles caused by changes in the intensity of the energy emitted by the source, such as arise from fluctuations in its temperature, variations with wavelength of the radiation, and background absorption due to carbon dioxide and moisture in any air lying in the path of the radiation. The use of balanced systems of this type has also fostered the development of automatic instruments which give a direct recording of the trans-

mission ratio. Means of balancing and the advantages of automatic recording are discussed and optical diagrams are given.

The Beckman I.R.2. spectrophotometer is a rock-salt prism instrument modelled on the well-known Beckman U.V. quartz spectrophotometer. An ingenious device is employed for obtaining adequate sensitivity in the measurement of the bolometer output. The energy from the infra-red source is caused to appear in the form of an alternating current which can be separated from general background "noise." This is done by interrupting the radiation from the Nernst glower ten times a second by a rotating chopper. The resulting pulsating bolometer output is amplified by an electronic circuit tuned to this frequency and is fed to a potentiometer arranged to indicate or record, at the selected wavelengths, the percentage transmissions or optical densities. Mention is also made of the recent Beckman Mark III instrument.

The Perkin–Elmer infra-red spectrophotometer differs from the Beckman chiefly in the use of the more conventional vacuum thermocouple-galvanometer system for energy measurement. The Perkin–Elmer Corpn Model 12A-B combines an electronic amplifier and recorder with the model 12A spectrometer—to form a very convenient recording desk unit. An optical diagram of the 12A analyser is given.

A British model constructed on more or less conventional lines is briefly described.

An advanced instrument designed in the Oppau laboratories of I.G. Farben during 1938–39 uses the dual-path approach in conjunction with a bolometer as energy detector, and gives a direct record of percentage absorption against wavelength. A noteworthy feature is the production of a linear wavelength scale on the recorder chart. This is done by automatically increasing the inlet slit width with increasing wavelength to offset the decrease in intensity of the infra-red beam. F. W. H. M.

Gas.

1708. Propane. (Refiner's Notebook No. 157.) W. L. Nelson. *Oil Gas J.*, 16.8.47, **46** (15), 113.—Tables are given showing: (*a*) the properties of pure propane; (*b*) the vapour pressure, latent heat, at $-70°$ F to $+120°$ F; density and heat content of liquid and vapour for the same range of temperatures; (*c*) specifications of propane, research, technical, and pure grades. Notes are given on filling propane cylinders: (1) if cylinder is dry; (2) if cylinder contains liquid (particularly heavy oil).

W. H. C.

Lubricants.

1709. Steam Turbine Lubrication Problems and Their Solutions. 4. Primary Rusting. A. Wolf. *Petroleum*, June 1947, **10**, 134.—Since one of the major causes of turbine oil deterioration in service is direct contact of the oil with the ferrous surfaces of the lubrication system and the rusting of these surfaces, it would appear desirable to protect them with a coating of enamel or paint.

Ordinary oil paints and oil-gum enamels being oil-soluble, not only does this nullify the purpose for which they were to be used, but the turbine oil is rendered emulsifiable and very prone to oxidation. Linseed and other drying-oil paints should never be used as they show minimum oil and alkali resistance and the organometallic "driers" present are powerful oxidation catalysts.

Paints with synthetic resin bases may be oil-proof under turbine lubrication conditions, but particularly severe tests should be given to coating compositions before acceptance for turbine systems. The possible presence of alkalis or other water-softening materials in boiler water carry-over should not be overlooked.

It is considered that, if the initial charge of oil in a brand-new turbine is properly inhibited against rusting and corrosion, no painting of the oil reservoir or other parts of the lubrication system is necessary.

Sluggish operation and sticking of the governor gear is the most common manifestation of the occurrence of obstructive solid deposits in a lubrication system. These deposits may result from rusting or deterioration of the oil.

If the oil is centrifugally purified, rapid accumulation of ferruginous solids in the centrifuge bowl gives warning of impending trouble. This will particularly be the case if the oil is suffering rapid oxidation catalysed by rust. If asphaltic and resinous

oxidation products of the oil accompany the ferruginous deposits it is too late to do anything but change the oil and clean out the lubrication system.

This should be anticipated by chemical examination of oil from the system at, say, monthly intervals. In turbines where previous charges of the same type of oil have given trouble more frequent samples, at least for acidity tests, should be taken. The rate of increase of acidity should then give ample warning of oil deterioration and the necessary steps can then be taken to avoid subsequent interference with the proper operation of the turbine.

The rate of acidity increase is valueless, however, for indicating whether rusting is occurring in a brand-new turbine filled with new oil. In this case rusting due to moisture alone may occur and would bear no relation to the condition of the oil, whereas in turbines which are not new the rusting is primarily due to the formation of certain acids in the oil. In this connexion, the newer and more highly refined the oil, the less protection it offers ferrous surfaces to attack by moisture while partially oxidized oils generally offer this protection.

Solvent-refined turbine oils possess many advantages over the older conventionally refined turbine oils, but until the discovery of efficient corrosion inhibitors, their use led to rusting troubles in new turbines. This is attributed to the removal by refining of natural polar constituents which would otherwise enable the oil to inhibit rust formation.

The employment of used oxidized turbine oil as a rust preventer in new turbine oils is discussed and deprecated.

The addition to highly refined oils of substances of the high molecular weight fatty acid type—*e.g.*, stearic acid, will prevent fresh water primary rusting both in the laboratory test (A.S.T.M. D.665–44(T)) and in new turbines.

More recent effective inhibitors comprise synthetic organic compounds containing an "active" phosphorus atom, derivatives of certain dicarboxylic aliphatic organic acids, etc. While these corrosion inhibitors are efficient for their purpose, they are not generally good anti-oxidants under service conditions. This may lead to rusting due to oil deterioration after comparatively short running time. Conversely, oxidation inhibitors, in general, will not serve as corrosion inhibitors.

This makes it necessary to inhibit best grades of turbine oil against both oxidation and corrosion so that they can be used in both new turbines and those already in use.

Sufficient polar bodies may be formed by mild oxidation, after a turbine has been running for a few weeks, as to render a corrosion inhibitor unnecessary. If a potent oxidation inhibitor is used, however, the delay in forming polar bodies may render the oil insufficiently capable of preventing primary rusting.

A potent rust inhibitor is especially valuable in cases where sea-water is used for cooling in marine turbines.

It is stated that when once polar bodies have formed a protective coating on the ferrous surfaces no further primary rusting will occur even with a change of oil containing no corrosion inhibitor.

Research in the U.S.A. has shown that in order to function as a rust preventer an organic acid must be not only polar and oil soluble but also insoluble in water. The lower organic acids strongly promote rusting, are water soluble and appreciably volatile at temperatures prevailing in turbine oil reservoirs and other parts of the lubrication system. F. W. H. M.

1710. Viscosity as a Technical Characteristic of Lubricating Oils. E. G. Semenido. *Petroleum*, May 1947, **10**, 110. (Translated and edited from the Symposium on The Viscosity of Liquids and Colloidal Solutions, Academy of the Sciences, U.S.S.R., 1944, **2**, 217–221.)—See Abstract No. 1255 (1945). F. W. H. M.

Engines and Automotive Equipment.

1711. British Power Units. Anon. *Flight*, 4.9.47, **52**, 250.—Up to date tabulated information of current aircraft gas turbines and piston engines is given. Mention is also made of several new gas turbines, and one or two piston engines for which full details will become available later. I. G. B.

1712. British Power Units. Anon. *Flight*, 11.9.47, **52**, 267.—Additional information and illustrations of British engines is given to supplement the data tables already published in the issue of 11.9.47. I. G. B.

1713. Naiad Announced. Anon. *Flight*, 4.9.47, **52**, 254.—This is the first announcement of the Napier Company's entry into the gas turbine field.

This is a 1590 E.B.H.P. airscrew unit, comprising an axial flow compressor, five straight-through parallel-sided combustion chambers and two-stage turbine.

Maximum diameter	28 in
Length	8 ft 6 in
Weight	1095 lb
Sea level or static conditions	18,250 r.p.m. 241 net jet thrust
Consumption	128·8 G.P.H.

I. G. B.

1714. 4800 B.H.P. G.E.C. Gas Turbine. Anon. *Motor Ship*, Sept. 1947, **28** (332), 221.—This prototype gas turbine is being built for industrial purposes coupled to a generator, but also suitable for gas-turbo electric propulsion. Turbine entry temperature is 1400° F and efficiency referred to turbine shaft output is about 17%, based on the lower heating value of Bunker "C" fuel oil. The fuel nozzles are of the air atomizing type. I. G. B.

1715. Survey of the Calculated Efficiencies of Jet Power Plants. J. H. Keenan and J. Kaye. *J. Aero. Sci.*, 1947, **14**, 437.—The elements of the plant are divided into propeller, diffuser, compressor, combustor, turbine, propulsive nozzle, and reciprocating engine. The major variables are pressure ratio, speed, and maximum temperature and diffuser efficiency. An attempt is made to compare the efficiencies of moving power plants with stationary ones so as to give the whole subject a degree of coherence. I. G. B.

1716. Aircraft Rocket Motors. A. D. Baxter. *Airc. Engng*, Aug. 1947, **19** (222), 249.—Rocket motors are distinguished by the oxygen bearing fluids they use: (*a*) Liquid oxygen; (*b*) Nitric acid; (*c*) Hydrogen peroxide.

General theoretical requirements are tabulated and there follows a discussion of fuels (hydrogen peroxide, hydrocarbon) and rocket motors (glide bomb, assisted take-off, aircraft main motor, main regulating valve, turbine speed control valves, turbo pump assembly, combustion chamber). I. G. B.

1717. Photography in Engine Research. H. G. Goulding. *Airc. Prod.*, Sept. 1947, **9** (107), 338.—In the concluding instalment the author reviews stroboscopic and photo-elastic practice and goes on to describe applications of cine photography at normal and high speeds. I .G. B.

1718. First Year's Performance of the "Auricula". Anon. *Motor Ship*, Sept. 1947, **28** (332), 230.—Operating conditions are described in this trial substitution of good grade boiler oil for diesel oil in the 4000 i.h.p. supercharged Hawthorn-Werkspoor engine.

With the exception of one cleaned piston, the remainder of the parts were precisely as removed from the engine and the condition of the various valves was little different from that which might be expected in machinery running on a far better class fuel.

Details are given of the constituents extracted by the centrifuging process. I. G. B.

MISCELLANEOUS.

1719. Competitive Fuel Prices. A. J. McIntosh. *Min. & Metall.*, 1947, **28**, 447–450.—Since 1940 the retail price of oil fuels has increased less than that of anthracite, resulting

in space heating by oil becoming cheaper. Tables are given showing the relative heating efficiencies for oil, gas, and coal, together with the B.Th.U. content of these fuels. Distinction is made between various types of coal and oil and between automatic and hand control for the firing of the former. Bituminous coal, where used, is still cheaper than oil and the latter has no advantage over natural gas, the supply of which is, however, often inadequate. Oil shows a definite advantage when compared to anthracite and future price trends indicate that this may be accentuated. V. B.

BOOKS RECEIVED.

British Chemical Plant. British Chemical Plant Manufacturers Association. London: B.C.P.M.A., 1947. Pp. 212.

This first post-war edition of *British Chemical Plant* is a valuable guide to British manufacturers of chemical plant, the term "chemical plant" being defined as "all plant, equipment, and accessories utilized in these processing industries where materials undergo a change of state or composition." Examples of such processes included in the book are those for the production of coal derivatives, coal-tar products, aromatic hydrocarbons and dyestuffs; petroleum and other products of mineral oil origin, including chemicals, synthetic rubber, synthetic and substitute fuels and derivatives.

In this book the ninety-five member firms of the B.C.P.M.A. illustrate and describe some of their products, and thirty-eight pages are devoted to a useful classified index of the products and services available from members of the Association. The work should prove of great value to buyers in the field of chemical plant.

The Petroleum Industry. Josephine Perry. New York: Longmans, Green and Co., Inc., 1946. Pp. 128. $2.

The foreword states that this book "deals briefly with a few of its [the petroleum industry] chief phases, chosen to give to the boys and girls of America a true picture of the magnitude and importance of an industry which so vitally influences the everyday life of the people."

Vapour Adsorption. Edward Ledoux. Brooklyn, N.Y.: Chemical Publishing Co., Inc., 1945. Pp. 360 + xvi. $8.50.

A compilation of the theories of numerous investigators and writers on absorption, followed by sections on the essentials of vapour and heat transfer, dynamic absorption, and industrial applications.

Practical Accounting for Oil Producers. Robert M. Pitcher. Tulsa, Oklahoma: Mid-West Printing Co., 1947. Pp. 645 + ix.

This revised edition incorporates changes in accounting procedure made necessary by regulations of the U.S. revenue authorities. Numerous problems peculiar to oil production accounting are presented, with solutions, and material for a complete set of accounts is given.

Those Who Know You Well Think Well of You. New York: American Petroleum Institute, 1946.

In 1946 the Opinion Research Corporation carried out, on behalf of the A.P.I., a nation-wide survey of attitudes towards the petroleum industry. In Part I the significant facts revealed by the survey are summarized, in Part II the highlights are cross-analysed to give a fairly complete picture, and in Part III complete tables of replies to all questions are given.

Oil Across the World. Charles Morrow Wilson. New York: Longmans, Green and Co., Inc., 1946. Pp. 318 + ix. $3.50.

The evolution of the pipeline is traced from its infancy, with particular reference to the petroleum industry and its growth. Finally, William G. Heltzel contributes a "Pipeline Manual" and there is a useful bibliography of thirty entries.

Early Geophysical Papers of the Society of Exploration Geophysicists. L. L. Nettleton (Editor). Tulsa, Oklahoma: Society of Exploration Geophysicists, 1947. Pp. 844 + iv. $6.

The Society of Exploration Geophysicists was organized early in 1930, but its journal *Geophysics* did not make its first appearance until January 1936. In the intervening period many geophysical papers were presented at meetings and published in various journals or in mimeographed form.

Many of these earlier scattered papers are not now available to the greatly increased numbers interested in the subject. Consequently the Society authorized their reproduction in the present single volume.

Technical Missions to Germany and Japan.

Further official reports have been received as follows:

F.I.A.T. REPORTS.

757. Production of Potassium Permanganate and Manganese Chloride. Pp. 19.
948. Report Index on German Aeronautical Research Documents. Pp. 104.
967. Polymerization of Acetylene to *cyclo*Octatetraene. Pp. 124.
968. Alcohols by Hydration of Olefines. Pp. 33.
1012. Screening Device for Slurries of Organic Chemicals. Pp. 4.
1073. Manufacture of Acetoacetic Acid Ethyl Ester at I.G. Farbenind. A.G., Hoechst am Main. Pp. 8.
1081. Manufacture of Diethylamine from Acetaldehyde. Pp. 14.
1095. Vapour-liquid Equilibria of Binary Hydrocarbon Mixtures. Pp. 23.

B.I.O.S. REPORTS.

1122. Avoidance of Toxic Hazards in Some German Chemical Factories. Pp. 68
1146. I.G. Farbenindustrie. The Separation of *ortho-*, *meta-*, and *para*-Xylenes and the Manufacture of the Derived Nitroxylenes and Xylidines. Pp. 64.
1154. Some Miscellaneous Organic Intermediates and Products: Manufacture (mainly) by I.G. Farbenindustrie. Pp. 47.
1210. Chemisch-Physikalische Versuchs, Anstalt der Marine, Kiel. Fuels, Lubricants, and Organization. Pp. 31.
1321. Control Instruments in the German Chemical Industry. Pp. 82.
1434. Bituminous Building Materials with particular reference to the "Kerasolith" Process for Chemical Tanking and Flooring. Pp. 37.
1487. Chemical Laboratory Instrumentation in Germany. Pp. 107.
1501. Aspects of Industrial Medicine and Hygiene in German Chemical Factories. Pp. 81.
1532. Fan Engineering in Germany. Pp. 17.

B.I.O.S./J.A.P./P.R. REPORTS.

821. Japanese Fuels and Lubricants, Research on Diesel and Boiler Fuel at the First Naval Fuel Depot, Ojuna. Pp. 114.
829. Japanese Fuels and Lubricants, Miscellaneous Oil Technology and Refining Installations. Pp. 86.

C.I.O.S. REPORTS.

xxxii–109. Interrogation of Dr. Haus Friedrich Gold. Pp. 25.

ABSTRACTS.

	PAGE
OILFIELD EXPLORATION AND EXPLOITATION.	
Geology	422 A
Geophysics and Geochemical Prospecting	438 A
Drilling	440 A
Production	441 A
Oilfield Development	444 A
TRANSPORT AND STORAGE ...	448 A
REFINERY OPERATIONS.	
Refineries and Auxiliary Refinery Plant	448 A
Cracking	449 A
Polymerization	450 A
Chemical and Physical Refining	450 A
Special Processes	451 A
Metering and Control	451 A
PRODUCTS.	
Chemistry and Physics ...	452 A
Analysis and Testing	455 A
Engine Fuels	457 A
Lubricants	458 A
Derived Chemical Products ...	459 A
Coal, Shale, and Peat	459 A
Miscellaneous Products ...	460 A
ENGINES AND AUTOMOTIVE EQUIPMENT	460 A
MISCELLANEOUS	462 A
BOOK REVIEW	463 A
BOOKS RECEIVED	464 A

AUTHOR INDEX.

The numbers refer to Abstract Numbers.

Allison, A. P., 1754
Ascher, E., 1781

Ballande, H. M., 1844
Barber, C. R., 1895
Barnett, B., 1867, 1868
Batchelder, C. D., 1858
Bates, R. L., 1747
Bell, A. H., 1737
Bell, E. A., 1850
Bender, P., 1897
Benson, S. W., 1891
Bernstein, H. J., 1877
Binder, R. C., 1916
Birch, S. F., 1883
Blackburn, M. A., 1707
Boss, R. L., 1755
Brockway, L. O., 1904
Brown, A. F., 1876
Buchan, R. C., 1816
Burch, J. G., 1812
Burgess, S. G., 1893
Burwell, J. T., 1914
Byers, A., 1886

Caesar, C. H., 1866
Calhoun, J. C., 1819
Carabasse, J., 1908
Cash, T. C., 1750
Chien, Jen-Yuan, 1897
Chiesa, P., 1912
Chronic, C. J., 1766
Claypool, C. B., 1754
Coffin, R. C., 1792
Cole, V. B., 1736
Coles, K. F., 1885
Crawford, B. L., Jr., 1898
Critz, J. S., 1758
Cullen, R. J., 1739

David, H., 1801, 1826
Deegan, C. J., 1900
Deflour, J. G., 1863
Dobbin, C. E., 1730
Doll, H. G., 1808
Doshier, A. W., 1752
Dunaway, W. H., 1902
Dyson, G. M., 1884

Eby, J. B., 1779
Edmunds, F. H., 1764
Egloff, G., 1872
Esarey, A. E., 1737

Ferry, L. F., 1924
Fohs, F. J., 1780
Forrest, J., 1925
Fournier, F. L., 1760
Foster, H. L., 1729

Garner, F. H., 1892
Gibbon, A., 1740
Gibbs, J. F., 1751
Gilmartin, T. H., 1873
Goldstein, R. F., 1906
Gordon, K., 1871
Gordy, W., 1880
Gouin, F., 1742
Grant, P. A., 1762
Gray, G. R., 1809
Greenland, K. M., 1875
Grim, R. E., 1721

Halbouty, M. T., 1756
Hall, A. S., Jr., 1916
Hall, C. C., 1870
Hall, T. A., 1864
Hardenberg, H. J., 1738
Hardin, C., 1756
Harris, S., 1798
Hart, M., 1803
Hasselmann, K. H., 1799
Haupt, H. W., 1805
Hickinbottom, W. J., 1886
Hildebrand, J. H., 1887
Hilseweck, W. J., 1758
Hodges, C. E., 1905
Horwitz, W., 1898
Houghton, J. L., 1894
Huxley, T. F., 1909

Ireland, H. A., 1725
Irwin, J. L., 1832
Ives, G. O., 1770, 1834, 1837

Jacini, G., 1912
Jillson, W. R., 1745
Jones, W. B., 1759

Karle, J., 1904
Kemler, E. N., 1824
Koester, E. A., 1736
Kronberger, H., 1876

Labee, F. H., 1726

Laird, W. M., 1732
Lang, W. B., 1748
Laudon, L. R., 1766
Leamon, G. F., 1869
LeGrand, J. C., 1808
Lloyd, E. R., 1813
Loetterle, G. J., 1750
Logan, L. J., 1727
Lomax, E. L., 1840
Lower, E. S., 1913
Lundberg, H., 1795
Lynton, E. D., 1777

McBain, J. W., 1910
McCaslin, L. S., 1821
McCaslin, L. S., Jr., 1823
McGaha, S. W., 1800
McGlamery, W., 1759
McReynolds, L. A., 1902
Masters, R. W., 1814
Mattix, E. D., 1874
Miller, B. R., 1806
Minne Van Der, J. L., 1882
Moody, G. B., 1728, 1731
Moore, C. A., 1741
Moore, P. H., 1865
Myscls, K. J., 1899

Nichols, E. A., 1793
Nickle, C. O., 1761, 1763
Nissan, A. H., 1892

Oberg, C. H., 1814
Olcott, P., 1830
Oldham, J. W., 1883

Parker, B. H., 1724
Pearse, B. H., 1746
Pomeroy, H. H., 1899
Price, W. A., 1749
Price, W. C., 1888

Radford, H. E., 1810
Rasmuss, J. E., 1836
Reeves, F., 1739
Reiter, W. A., 1723
Rice, O. K., 1890
Richards, H. G., 1743
Rigamonti, R., 1911
Rockwell, R. A., 1858

Rogers, D. T., 1905
Rymer, T. B., 1896

Scherbatskoy, S. A., 1873
Scrafford, B., 1763
Shepherd, G. F., 1757
Short, E. H., Jr., 1802
Shreve, C. W., 1899
Sloss, L. L., 1732
Smith, C. D., 1751
Smith, S. L., 1870
Stach, L. W., 1737
Steingr, H., 1869
Stratton, E. F., 1808
Streets, R. E., 1901
Sutton, A. M., 1836
Swift, G., 1873
Szwarc, M., 1881

Taso, P. H., 1864
Taylor, H., 1734
Taylor, W. G., 1822
Thompson, B. F., 1860
Thornton, O. F., 1820
Tiratsoo, E. N., 1774, 1784, 1785, 1786
Trimble, H. M., 1902
Tripp, R. M., 1791
Tuyl Van, F. M., 1734

Vaughan, W. E., 1867, 1868

Walker, J. M., 1800
Walsh, A. D., 1888, 1889
Walters, R. F., 1735
Walton, P. T., 1733
Weber, G., 1804
Weelden Van, A., 1790
Williams, C. G., 1903
Williams, N., 1815
Williams, V. Z., 1878, 1879
Wilson, G. M., 1765, 1811
Wilson, W. H., 1796
Woods, W. H., 1817, 1818
Working, E. B., 1910

Zobell, C. E., 1720
Zunino, J. J., 1733

Oilfield Exploration and Exploitation.

Geology.

1720. Bacterial Release of Oil-Bearing Materials. C. E. Zobell. *World Oil*, 25.8.47, **126** (13), 36; *Oil Gas J.*, 2.8.47, **46** (13), 62.—In experimental work bacteria have been observed to release mineral oil from sea sand and other solids on which the oil had been adsorbed. Oil has also been released from Athabaska tar sands covered with nutrient solution supporting sulphate-reducing bacteria. Some at least of the oil released from the Athabaska tar sands was less dense than the original tar. In some cases the oil was emulsified, and there is evidence of its modification or destruction. These effects were stronger with mixed cultures.

Bacteria has been found to release oil from oily shales. There is no evidence, however, to show that bacteria can convert the bituminous matter of oil shale to crude. No oil was released from natural rock asphalt. Oil has been released bacterially from oil-sand cores.

Many bacterial species dissolve carbonates by producing organic acids. This may aid in freeing oil. Tiny bubbles of CO_2 have a buoyant effect on oil droplets. Bacterially produced methane or hydrogen would act similarly. Some bacteria have strong affinity for solids and are able to push off films of oil or grease. Bacteria may produce surface tension depressants, and surface-active substances may play a part in liberating oil from solids.

Bacterial decay may set free oil from organic tissue. Bacteria may also synthesize or destroy oil.

The characteristics of sulphate-reducing bacteria are described, and the possibility of introducing bacteria into formations in order to liberate oil is discussed briefly. It is noted that further investigation of this point is required. G. D. H.

1721. Relation of Clay Mineralogy to Origin and Recovery of Petroleum. R. E. Grim. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1491–1499.—The clay-mineral concept of the nature of clays and shales is briefly discussed in its relation to problems of the origin and recovery of oil and gas. Clay minerals that make up a sediment are to a considerable degree the result of diagenetic changes in the environment of accumulation. Diagenetic changes suggested by present available data are considered. The relations of various clay minerals in certain conditions are the key factor in the transition of organic matter to petroleum.

The properties of clay minerals are considered as a basis for analysing the effect of water with dissolved electrolytes, moving through a sand, on a clay in the sand. The characteristics of the clay minerals are believed to be significant factors in the recovery of oil. E. N. T.

1722. Evaluation of Oil Exploratory Methods. J. J. Zunino. *World Oil*, 7.7.47, **126** (6), 13 (*International Section*).—In searching for oil it is desirable to determine whether (*a*) sedimentary rocks are present; (*b*) porous and permeable rocks are within reach of the drill; (*c*) a cap rock exists; (*d*) source rocks are present; (*e*) metamorphism has not destroyed the oil; (*f*) there is a suitable trapping structure; (*g*) an accumulation has been subjected to flushing by circulating waters. The significance of each of the above points is discussed, and the means whereby each point can be answered are described. G. D. H.

1723. Contouring Fault Planes. W. A. Reiter. *World Oil*, 14.7.47, **126** (7), 34.—A fault plane can be defined by a system of contours which will display its form. The gap in a formation broken by an included fault can be shown when fault contours are used, and altogether they provide a fuller picture than sections. G. D. H.

1724. Oil; Its Origin, Accumulation. F. M. Van Tuyl and B. H. Parker. *World Oil*, 14.7.47, **126** (7), 39; 21.7.47, **126** (8), 48.—The oil source beds in most pools are not known with a reasonable measure of certainty. Marine shales are believed to be the commonest source, but at times a profusion of skeletal material in limestone and the presence of much organic matter may clearly point to the rock having been a source

rock. The close relationship of the Chattanooga and Cherokee dark shales to some oil reservoirs seems significant, but not all black shales are potential source rocks. In some cases the oil may be indigenous to the reservoir rock, and some reef and delta deposits may be of this type. Some of the oil and gas pools in the Wasatch in the Rocky Mountain area have been formed in lakes. Oil in lenses is best explained by a local source. Multiple sand accumulations may or may not have derived from a single source, depending on conditions.

Oily substances and waxy materials containing hydrocarbons occur in organisms and in modern sediments, but no undoubted petroleum has been found. Ancestral crude might be thick like a residuum.

Tight beds round oil reservoirs may have suffered post-accumulation cementation. Late accumulation does not necessarily mean late generation of oil. Concentration at more than one epoch seems possible.

Faulting allows readjustment and even dissipation of oil accumulations. Oil in fractured shales as at Florence seems likely to have been generated after the initial compaction required to permit fracturing.

Extensive lateral or vertical migration is not necessarily needed to form oil accumulations. Most lateral movement is along permeable beds, and is possibly towards the borders of basins. The characteristics of barren and productive structures should be compared. In some cases barren structures have greater thicknesses of beds.

In the Rocky Mountain area barren structures on the borders of basins have less saline waters than those producing deeper in the basins.

Asphalt may be washed out to sea and deposited in near-shore sands or limestones.

G. D. H.

1725. Terminology for Insoluble Residues. H. A. Ireland and others. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1479–1490.—The development of the use of insoluble residues for correlation since 1940 has resulted in a diverse terminology which needs standardization. A group of geologists familiar with residue work have agreed upon terminology and definitions, and developed the outline included in this article. The contents of the outline are based on description rather than on genesis, since the genesis of many constituents of residues is not known or is controversial. The outline and its contents are submitted as a guide to new workers and as a common source of agreement among those most familiar with correlation and identification using insoluble residues.

E. N. T.

1726. Exploratory Drilling in 1946. F. H. Lahee. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 917–930.—During 1946, 5752 exploratory holes were drilled in the United States. Of these 3125 were new-field wildcats, 1270 were new-pool tests (including new-pool wildcats, deeper-pool tests, and shallower-pool tests), and 1357 were outposts. Among the new-field wildcats, 333 were successful; among the new-pool tests, 380 were successful; and among the outposts, 424 were successful.

The total exploratory footage drilled was 22,167,561 ft in the 5752 holes, or 3854 ft per hole. These figures are comparable with 23,030,266 ft drilled in 5613 exploratory holes, with an average depth of 4103 ft, in 1945.

E. N. T.

1727. Independents' Rôle in Finding Reserves. L. J. Logan. *Oil Wkly*, 23.6.47, **126** (4), 54.—During 1946 two-thirds of the successful exploratory wells in the U.S.A. were drilled by the smaller companies and independents. Relatively they had more failures than the majors and middle-sized concerns. The results were generally similar in 1945. It should be noted that through co-operation in financing the majors actually make possible many discoveries which are attributed to independents, and eventually the former acquire ownership of a relatively large proportion of the proven reserves. Thus at the beginning of 1946, 32 companies held 81·5% of the proven U.S. reserves.

Tables summarize the exploratory well results of 37 large U.S. companies, and of all other companies in the U.S. in 1946.

G. D. H.

1728. Developments in California in 1946. G. B. Moody. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 931–946.—366 exploratory wells were completed in 1946, a total exploratory distance of 1,584,647 ft or 300 miles. The total number of completions,

total footage, and percentage of success for the different types of exploratory wells were as follows:

	No. of wells.	Footage.	Percentage wells successful.	Percentage footage successful.
New-field wildcats . .	211	950,855	8·5	11·1
New-pool wildcats . .	47	230,720	27·7	26·8
Deeper-pool test . . .	29	78,695	10·3	6·8
Shallower-pool tests . .	4	19,585	75·0	78·3
Outposts	75	304,792	44·0	38·6

All exploratory wells were 19·1% successful as to number and 19·4% successful as to footage; the analogous figures for 1945 were 21·0% successful as to number of wells and 17·5% successful as to footage.

30 oil pools and fields and 7 gas pools and fields were discovered in 1946. New pools, new fields, and successful outpost wells added about 132,000,000 brl to oil reserves and about 110,000,000 M.c.f. to dry gas-field gas reserves. None of the new pools or fields can be rated as major discoveries. Production in 1946 was approximately 317,500,000 brl (including condensate) and 528,000,000 M.c.f. of gas. There were 57 active exploratory wells at the close of 1946. E. N. T.

1729. Palæozoic and Mesozoic Stratigraphy of Northern Gros Ventre Mountains and Mount Leidy Highlands, Teton County, Wyoming. H. L. Foster. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1537–1593.—This area was a shelf zone bordering a deeper part of the Rocky Mountain geosyncline during the Palæozoic and Mesozoic eras. Sediments deposited are relatively thin as compared with those on the west and southwest of the northern Gros Ventre Mountains and Mount Leidy Highlands. The rocks range from pre-Cambrian to Tertiary in age, with all of the systems present, excepting the Silurian. The Palæozoic strata are about 3500 ft thick, and the Mesoic about 12,000 ft. E. N. T.

1730. Geological Features of the Rocky Mountain Oil Region. C. E. Dobbin. *Oil Wkly*, 3.2.47, **124** (10), 22.—Oil has been produced in Mississippian to Oligocene beds in the Rocky Mountain region, and there are pre-Mississippian shows. The old oils tend to be heavier than young oils. Almost all the traps were formed in the Laramide revolution, and the Sweetgrass Arch is the only important area with oil and gas directly related to pre-Laramide folding. About 57% of the oil and gas is associated with domes and anticlines with little faulting; 14% occurs on terraces and monoclines, and 26% is connected with structures with important faults.

There are many promising structures which contain non-commercial amounts of oil and gas, and those which produce are rarely filled to the limit. It is believed that there has been extensive flushing, and oil has been preserved only in the more favourably placed traps.

The discussion covers the origin of the oil- and gas-traps, the age and character of the producing zones and types of traps. A number of structural maps are included.

There are considerable accumulations of gas rich in carbon dioxide. A number of gases yield helium (up to 7%) and nitrogen (up to 81%). Extensive deposits of oil shale occur, and it is estimated that if 60% of the total shale in northwest Colorado in beds of 3 ft or more thick, and giving at least 15 gal of oil per ton on distillation, was retorted the crude shale oil would amount to 40,640,000,000 brl. G. D. H.

1731. Upper Montana Group, Golden Area, Jefferson County, Colorado. J. D. Moody. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1454–1471.—Examination of the Montana group in the vicinity of Golden and Morrison, Jefferson County, has revealed a series of beds more than 1200 ft thick containing a well developed and varied Fox Hills fauna. The base of the Fox Hills sandstone, as restricted by the U.S. Geological Survey, lies more than 1000 ft above the typical Fox Hills fauna in the section.

The basal members of the overlying Laramie formation rest on different zones of

the upper Montana at different localities within the area. The Montana shales below the restricted Fox Hills are readily divisible into upper, middle, and lower Pierre, as has been established in Colorado. E. N. T.

1732. Devonian System in Central and Northwestern Montana. L. L. Sloss and W. M. Laird. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1404–1430.—The Devonian strata of central and northwestern Montana are confined to an Upper Devonian age. In central Montana these rocks are divided, in order of increasing age, into the Three Forks formation, predominantly shale; the Jefferson formation, composed of an upper dolomite member and unnamed basal unit of shale and shaly dolomite which bears a transgressive relationship to the underlying Ordovician and Cambrian. In northwestern Montana these terms are not applicable and the Devonian is divided in descending order, into arbitrary units, A, B, and C. Unit A is dolomite and anhydrite, or evaporite-solution breccia, unit B is dense limestone, and unit C is a red shale and shaly dolomite sequence resting on the channelled surface of the Upper Cambrian.

Oil is produced from the Devonian of south-central Alberta and gas has been found in it in Montana. Petroleum possibilities appear to be confined to the dolomite of the Jefferson formation and unit A, and it is suggested that these possibilities may have been enhanced by favourable depositional environments and post-depositional effects. E. N. T.

1733. Oregon Basin Field, Park County, Wyoming. P. T. Walton. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1431–1452.—The Oregon Basin oil and gas field is in north-central Wyoming on the western margin of the Big Horn basin, a closed Tertiary-filled structural basin. Adjacent to the synclinal axis of the asymmetrical Big Horn basin, the Oregon Basin is a large anticline having 1600 ft of closure. Transverse tensional and shear faulting is present along the axis, both in the surface and subsurface strata. The oil and gas accumulation is present primarily because of this structural trap.

The most highly developed and important production is black, 20–22°-gravity oil from the Permian Embar limestone and the Pennsylvanian Tensleep sandstone. This productive area occupies only 40% of the total area within the closing contour. Black, 18°-gravity oil is also produced from the Mississippian Madison limestone. Commercial amounts of gas occur in the Cretaceous Frontier and Cloverly sandstones and the Triassic Chugwater sandstones, and both separately and in association with the oil in the Embar limestone. The Oregon Basin is one of the more important reserves of black oil in Wyoming, having an estimated ultimate production in excess of 150,000,000 brl.

A non-commercial showing of light paraffin-base oil was found in the basal Cambrian Flathead sandstone. E. N. T.

1734. Upper Ordivician Shales in Central Kansas. H. Taylor. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1594–1607.—Shales approximately equivalent in age to Maquoketa beds in Iowa and to Sylvan strata in Oklahoma form the topmost Ordovician over most of Central Kansas. They consist of two members: (1) an upper dolomitic gray shale, which is siliceous and cherty in some areas, and (2) a lower soft flaky shale. These beds are thickest in the central part of the Salina basin and also in a belt extending north–south through western Harvey County. They disappear on the flanks of the Nemaha arch and of the Central Kansas uplift, probably because of truncation, and also thin and disappear in the region of northern Sedgwick County, probably because of non-deposition in places, coupled also with some truncation. Possible sources of the shaly material include the Central Kansas uplift, Ozarck dome, and volcanic dust dropped by winds into the muddy upper Ordovician seas. E. N. T.

1735. Buried Pre-Cambrian Hills in Central Kansas. R. F. Walters. *World Oil*, 4.8.47, **126** (10), 28.—See Abstract No. 20 (1947).

1736. Developments in North Mid-Continent in 1946. E. A. Koester and V. B. Cole. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 999–1005.—Wildcat discoveries located in Kingman, Barber, Harvey, and Ellis counties of Kansas promise prolific production or indicate a pool of more than average size.

Kansas produced 98,193,272 brl of crude oil and casing-head gasoline in 1946, slightly less than the production for 1945. Gas production amounted to 122,600,000,000 cu. ft. Development of the huge Hugoton gas field in the southwestern part of the State continues, but the increased runs from that field have not made up for declines elsewhere.

Return to closer spacing in the development of Kansas fields is shown by the dry-hole percentage of 32·2% compared with the figure of 41·5% for 1945 and 50·5% for 1944, when nearly all wells were located on a 40-acre basis. E. N. T.

1737. Developments in Illinois and Indiana in 1946. A. H. Bell and R. E. Esarey. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 979–987.—Drilling in Illinois and Indiana increased by 42% in 1946 as compared with 1945 and production increased by 2¼%. There was little deep testing and nearly all of the new wells produced from sandstones and limestones of the Mississippian system.

The rate of drilling in 1947 will probably decline from the high level of 1946, but be higher than that of 1945. Drilling is anticipated in the pre-Mississippian strata, especially of the Silurian in the western marginal area of the Illinois basin.

E. N. T.

1738. Developments in Michigan in 1946. H. J. Hardenberg. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 988–998.—Of the 259 wildcats drilled during 1946, 26 were completed as producing wells. 12 oilfields and 6 gas fields were discovered, 5 oilfields and 2 gas fields were extended and a new pay zone was found in one field. Well completions totalled 822 compared with the 801 of the previous year. 45% of the wells were productive at an average rate of 651 brl per well and an average initial production of gas wells was 7,371,000 cu. ft. per well. Total footage drilled was 1,705,694 ft, approximately 15% less than in 1945. Wildcat footage was 608,839 ft.

Oil production declined approximately 1% to a rate of 17,074,518 brl. Gas production showed an increase of 2% at a rate of 23,774,495,000 cu. ft.

Permits were issued for 186 geological tests, of which 60% were used in western Michigan. Two secondary recovery projects were started in Michigan in 1946.

E. N. T.

1739. Developments in Oklahoma in 1946. R. J. Cullen. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1006–1014.—Oklahoma produced 136,807,000 brl of crude oil in 1946, a decline of 2,420,000 brl from 1945. Reserves reported are 898,186,000 brl, or 8,347,000 above last year. More than 3000 wells were drilled. Exploration accounted for 588 wells, discovering 71 oil pools, 22 gas pools, 18 extensions, and 3 new producing formations in old pools.

The most promising discovery was the Southwest Antioch pool in Garvin County, discovered by Globe–Vickers' Gibson No. 1. E. N. T.

1740. Shoreline Trend May Develop Oklahoma Golden Horse-Shoe. A. Gibbon. *Oil Wkly*, 19.5.47, **125** (12), 39.—There is a potential shoreline reservoir along the western arc of the Pauls Valley uplift in McClain and Garvin counties, Oklahoma. The production is from the Pennsylvanian, and may cover a strip 20 miles long and about 2 miles wide, with reserves of 50–100 million brl. The Deese and Gibson sands probably wedge out on the western flank of the uplift along an arc giving continuous production. The Hunton and Bromide also produce.

The pools are North and East Lindsay (Pennsylvanian, Hunton, and Bromide production), Southwest Wayne (Pennsylvanian and Hunton), Southwest Maysville (Bromide), Southwest Antioch (Pennsylvanian), Northeast Elmore and Katie (Pennsylvanian), and Eola (Bromide). East Lindsay has folding and faulting possibly lying on the extension of the Pauls Valley uplift. Eola is a further structural prospect.

Seismic work has shown the form of the Ordovician. The development of the pools belonging to this stratigraphic trap belt is briefly described. Producing depths exceed 6000 ft. Wells cost $90,000–$360,000 each.

A map and cross-section are included. G. D. H.

1741. Coring in Burgess Sandstone. C. A. Moore. *Oil Wkly*, 16.6.47, **126** (3), 38.—The South Moore pool of Cleveland County, Oklahoma, was opened in 1944, with

production from the second Wilcox (Bromide sandstone) at 8833 ft. A later well was completed in the Burgess sand at 7742–7772 ft. The Burgess sandstone (Lower Pennsylvanian) is about 400 ft below the Oswego and 150 ft above the Mayes (Mississippian) limestone. The same formation is productive at West Moore. Burgess sandstone zone samples show hard quartzitic sandstones, often cherty, with alternating detrital limestones and hard shales. There are very few porous sands. Wire-line coring gave good recoveries, and loose sand beds were found in the upper part; these give the main producing zone, and litin the topmost 30 ft with a 10-ftcap of hard quartzitic sandstone.

Below occur limestone, sandstone, and shale with staining, further limestone, underlain by shale and quartzitic, oil-streaked sandy limestone, siliceous limestone and sandy shale with limestone. Gamma-ray and neutron logs have been made through the cored section as well as electric logs, and comparisons have been made with the cores.

The detailed core descriptions and the various types of logs are included.

G. D. H.

1742. Southern Oklahoma Oil. F. Gouin. *Oil Wkly*, 23.6.47, **126** (4), 34.—The Wheeler field of southern Oklahoma was opened in 1904, followed possibly by the Cruce gas field in 1912. Healdton was discovered in 1913, and thence forward a succession of finds were made.

Southern Oklahoma was part of a geosynclinal trough until early Pennsylvanian time, and there is a good development of Cambrian to Lower Pennsylvanian beds. At the end of the Lower Pennsylvanian the main Wichita uplift occurred and created northwest–southeast folds in addition to the Wichita mountains. The Arbuckle uplift took place at the end of the Pennsylvanian, and was followed by much denudation on the highs. The Permian was marked by Red bed deposition. Elevation in Triassic and Jurassic times was followed by Cretaceous submergence. The formations are briefly described and producing horizons are noted.

The Permian rocks tend to be arched over old highs, and most fields in southern Oklahoma have been discovered by some form of geological work. Seeps are important. The oil and gas fields are grouped in a tabulation, according to age of producing horizons, and these range Permian to Cambrian. Brief notes are given on production. The fields are long-lived. Proved reserves may be 715,000,000 brl in post-Mississippian beds.

A map and section are included.

G. D. H.

1743. Developments in Atlantic Coast States between New Jersey and North Carolina in 1946. H. G. Richards. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1106–1108.—7 wells were drilled during 1946, all dry. A test drilled at Cape Hatteras reached a depth of 10,054 ft, with "basement" at 9878 ft. 5 wells were drilled near Merrimon, all of which reached "basement" at about 4000 ft. Standard also drilled a dry hole near Ocean City which was abandoned at 7710 ft in the Cretaceous. The Rose Hill oilfield of Lee County continued to produce.

E. N. T.

1744. Developments in Appalachian Area in 1946. Appalachian Geological Society. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 959–978.—*New York.* In the Oriskany gas area 26 wells were completed or drilling in 1946 as compared with 36 in 1945. There were no new discoveries. Three producers were drilled in the South Addison pool with a total open flow of 9927 M.c.f. 15 wells were drilled to the Medina sand, the producers making about 2000 M.c.f. In the oil-producing area completions increased from 1349 in 1945 to 1739 in 1946 and the daily average production increased from 12,402 brl per day in 1945 to 12,828 brl per day in 1946.

Pennsylvania. A decline of 8% occurred in the total number of wells completed in the shallow-sand territory of western Pennsylvania (Upper Devonian or higher) during 1946, as compared with 1945. The greatest drilling activity was at the Coryville oil pool in northeastern McKean County, discovered in 1945. Production increased 4·3% as compared with 1945 in the Bradford field. Extensions were made to the small Gordon sand oil pool in North Strabane Township, Washington County. Oil production in the middle and southwestern districts of Pennsylvania increased 6% as compared with 1945. The Haskell sand gas pool was the most active. 14 deep wells

were completed in 1946. 6 of these were gas wells, 1 was drilled for gas storage, and 7 were dry holes. 3 opened new pools.

Ohio. 1293 wells were listed in Ohio, of these 408 or 31½% were dry, 547 were gas wells, and 338 were oil wells. 203 wells tested the sands above the Berea, 281 penetrated the Berea, 14 were drilled into the Ohio shale of Devonian age, 40 were drilled as Oriskany tests, and 695 were drilled through the Clinton sand. 132 wells were drilled in the Canton Clinton gas field, with an average flow of 2500 M.c.f.

The Oriskany sand activity centred in Columbiana County. Open flows exceeded 2000 M.c.f. with rock pressures of over 1700 lb, the rapid depletion and the encroachment of water is discouraging. 18 wells were drilled in the Trenton fields in north-western Ohio, where 6 oil wells, 3 gas wells, and 9 dry holes were completed.

There were 5 sub-Trenton tests drilled in the State; 4 were in Lorain County, of which 3 were dry, 1 making 67 M.c.f. of gas from the St. Peter horizon at 4125 ft. The other sub-Trenton test encountered a small flow of gas from dolomite at 6558 ft, but drilled water at 6704 ft.

West Virginia. Natural gas development in Wyoming and Nicholas counties continues, and a second well producing gas in the Huntersville chert and Oriskany sand was completed in Tucker County.

Rate of drilling is somewhat less than 1945, but rate of abandonments of both oil and gas wells has increased. No new gas pools have been discovered except the single completion in Preston County.

Kentucky. Exploratory drilling in Kentucky in 1946 involved the testing of beds from Pennsylvanian to Cambrian. Successful new-field wildcats were confined to the Mississippian of western Kentucky and the Upper and Middle Ordovician of south-central Kentucky. There were 4 Knox tests of note, one of which penetrated the Cambrian and stopped in porphyritic rhyolite. E. N. T.

1745. Thrust-Shatter Theory of Oil Accumulation. W. R. Jillson. *World Oil*, 4.8.47, **126** (10), 40.—The Powell Valley anticline runs northeast–southwest for 65–70 miles and has a structural height of 500–1000 ft. It is crossed by the Cumberland overthrust block, 125 miles long and 25 miles wide, and bounded on the northwest by the Pine Mountain fault and by the St. Paul fault on the southeast. The thrusting took place in late Palæozoic time and some 15,000 ft of Palæozoic beds were thrust 7–10 miles northwest across the Powell Valley anticline on a shear plane cutting across from Cambrian to Devonian. Erosion has removed all but a few hundred feet of Lower Ordovician and Upper Cambrian beds, and in places streams cut through these to expose Silurian and Ordovician. The first drilling at Rose Hill, Lee County, Virginia, was in 1922, and now 50 wells have been drilled. This fold was largely formed before the thrust and there are thick deposits of fine fault breccia just below the thrust.

At Rose Hill a little oil has been found in the Clinton sandstone at shallow depths, but the main production is from the Trenton, with minor amounts deeper in the Ordovician. The paraffin base oil is obtained at 50–200 brl/day per well initially. The Trenton is of low porosity, and therefore production is believed to be from fissured zones. The shattering in the crestal zone of the Powell Valley anticline is considered to be due to the shearing stresses set up by the thrusting of the overthrust sheet across it. In extreme cases this shattering may extend 3000–3500 ft below the thrust, and commonly it is found down to 1200–1700 ft. Shaly beds still act as seals. It is thought that the zone of most intense shattering is confined mainly to the truncated crest of the subsurface structure. G. D. H.

1746. Virginia Field Confirms Fenster Production. B. H. Pearse. *World Oil*, 8.9.47, **127** (2), 50.—Virginia's only oilfield, Rose Hill, in Lee County, was discovered in 1942. A dozen successful completions have been made with outputs ranging 5–50 brl/day initially. All are in the Trenton at depths of 1000–2000 ft, and in "windows" where rocks beneath an overthrust are exposed. The oil is 45°-gravity, amber-coloured and paraffin-base.

The Rose Hill field is the first field in the Appalachian folds. Similar structures occur elsewhere. The first well in Lee County was drilled in 1910, about 8 miles southeast of Rose Hill. Some oil was found in wells drilled later, and their findings are described. Rose Hill lies on the Powell Valley anticline. G. D. H.

1747. Developments in Arizona, Western New Mexico, and Northern New Mexico in 1946. R. L. Bates. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1039–1044.—At the Barker Creek dome 2 additional deep gas wells were completed and a desulphurizing plant was built. 15 gas wells completed in the Fulcher Basin field established its continuity with the Kutz Canyon field. The Estancia Valley carbon dioxide field was abandoned, but development in the Bueyeros area was started. 2 dry holes were completed in Arizona and 10 in northern New Mexico of which 5 reached the pre-Cambrian. E. N. T.

1748. Occurrence of Comanche Rocks in Black River Valley, New Mexico. W. B. Lang. *Bull. Amer. Ass. Petrol Geol.*, 1947, **31**, 1472–1478.—The discovery of Comanche fossils in Black River Valley provides a means for more accurately defining the position of the Comanche shorelines in southeastern New Mexico. An explanation is offered for the anomalous occurrence of these fossils and one which may help to clarify previous misconceptions of the geology of the area. Reference is made to related early geologic explorations in the region. E. N. T.

1749. Equilibrium of Form and Forces in Tidal Basins of Texas and Louisiana Coast. W. A. Price. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1619–1663.—The study of 31 oval, enclosed tidal basins of a variety of sizes in soft sediments shows approximate dynamic equilibrium, regardless of basin origin, between average width and maximum depth, scour and fill, fetch (width), and wave base to the maximum observed depth of 16·5 ft. On the humid eastern coast, basins are commonly wide, shallow, and directly alluviated by rivers. The equation of straight line average where y = depth in ft, and x = width in miles, is $y = 0{\cdot}41x + 3{\cdot}0$. On the non-humid southwestern coast, basins are proportionately narrower; straight line average is $y = x$, or a ratio of 1 : 1. Here most elongate water bodies have become segmented to oval form by spits, bars, tidal deltas, and wash-over fans. Alluviation commonly overcomes disposal in inner segments entered by rivers, filling them while leaving outer segments in equilibrium. Depths in tidal channels are not used. Water bodies for which data are incomplete, those with very irregular outlines, and unsegmented parts of coastal lagoons are excluded.

Maximum departure from average depth during the record period has been 2–3 ft, *i.e.*, 30%, essentially within the range of incidental scour and fill and secular sea-level change. A shallowing of most basins since early surveys by 0·5–1·5 ft is believed to show mainly silting due to man's activities. Heavier silting and segmentation are caused by ship-channel excavation across the basins. Segmentation, artificial or natural, tends to restore equilibrium, following or being followed by bottom filling. Modification of form is most evident after great storms or major engineering works.

In spite of postulated eustatic sea-level rise during the present century, the tidal basins have maintained width–depth ratios, in some cases actual depths, during equilibrium conditions in the cartographic period. Some bays sank more than 10 ft in recent centuries, but now have equilibrium of form. E. N. T.

1750. Developments in East Texas in 1946. T. C. Cash and G. J. Loetterle. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1059–1070.—8 new oil-producing areas and 4 new gas-producing areas were discovered during 1946. 3 of the oil discoveries produce from the Woodbine formation; these are North Gallatin and William Wise in Cherokee County and Norman Paul in Wood County. Oil production in the sub-Clarksville sand of the upper Eagle Ford also occurs in the Norman Paul field. Production in the South Flynn field in Leon County is considered to be from an undifferentiated Woodbine–Eagle Ford section.

Two of the new oil discoveries produce from the Paluxy formation; these are Boynton and Mt. Sylvan. 2 new fields are in the Travis Peak formation, *i.e.*, Elysian Fields and Lassater.

4 new gas-producing areas are Pine Hill and South Henderson in Rusk County, which produce from the Travis Peak; Flower Acres in Bowie County, produces from the Smackover, and Huxley in the Shelby County produces from the Pettit zone of the lower Gelen Rose. 6 older fields revealed new producing zones. E. N. T.

1751. Developments in North and West-Central Texas in 1946. J. F. Gibbs and C. D. Smith. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1045–1051.—102 discoveries were

made in the north and west-central Texas district in 1946, including 21 outposts, 2 shallower-pool tests, 4 deeper-pool tests, 1 field-development well, 28 new-pool wildcats, and 45 new-field wildcats. These are comparable with a total of 125 discoveries in 1945.

3007 wells were drilled, of which 653 were exploratory, comparable with 2240 wells drilled in 1945, including 468 wildcats; increased drilling activity being 26%. 57,840,000 brl of oil were produced during 1946, compared with 54,283,000 in 1945, an increase of 3,557,000 brl. Other discoveries: (1) the Manning O'Connor, "Caddo" limestone in southwestern Stephens County; (2) reflection seismograph discovery of fields in Throckmorton County; (3) Strawn production in east-central Haskell County; (4) Eskota field producing from a Canyon reef; (5) explorational activity in district west of the axis of the Bend Arch. E. N. T.

1752. Developments in Texas Panhandle in 1946. P. A. Grant and A. W. Doshier. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1015–1017.—There was a marked decrease in drilling operations in the Texas Panhandle in 1946 compared with 1945. In all, 317 wells were drilled: 149 were completed as oil wells, 123 as gas wells, and 45 as dry holes.

Slightly less than 30 million brl of oil were produced, more than a million less brl than in 1945. More than 881 billion cu. ft. of gas were produced in 1946 which is 85 million cu. ft. less than the previous year.

Only one of the exploratory holes drilled in the Panhandle in 1946 was successful. The Texas Company's M.S. Bills No. 1 in Wheeler County, drilled as an extension to the East Shamrock pool was completed as a 29-brl pumper. 2 exploratory holes were drilled in the Anadarko basin in 1946. The British American Oil Company's Buzzard No. 1 in Ochiltree County, and O. P. Flynn's Hoover–Patton No. 1 were both dry and abandoned. E. N. T.

1753. Developments in South Texas in 1946. B. Scrafford. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1052–1058.—A decline occurred in the rate of wildcat developments in 1946 as well as a decrease in the rate of new discoveries. The 15,384 oil wells in the South Texas district produced 137,934,170 brl, approximately 5% of the world's production, 8% of the United States production, or 18% of the annual oil production of Texas. The 1085 gas wells tendered to gas lines 510,399,785 M.c.f. of gas during 1946. Over 54% of all developments took place in the Frio–Vicksburg trend which supplies 76% of the production of the district. E. N. T.

1754. Developments in Upper Gulf Coast of Texas in 1946. A. P. Allison and C. B. Claypool. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1071–1077.—In 1946, 679 wells of all classifications were drilled in the Upper Gulf Coast of Texas, of which 320 were exploratory and 359 oilfield development wells. Of the exploratory wells, 121 were new-field wildcats of which 14 were successful and 107 failures; 112 were new-pool wildcats of which 40 were successful and 72 were failures; 83 were extension wells or outposts, of which 39 were successful and 44 were failures.

679 drilling operations were undertaken, compared with 911 during 1945. New-field discoveries decreased from 26 in 1945 to 14 in 1946, while new sand discoveries in proved fields increased from 72 in 1945 to 80 in 1946. The new-field discovery rate was 1 out of 8·6 wildcat wells as compared with 1 out of 5 in 1945.

Of the 14 fields discovered in 1946, 6 were gas-condensate producers and 8 were oilfields. At the end of the year 1 was abandoned and 8 were still in the 1-well stage. Production remained at approximately 183 million brl.

The Edwards limestone of Lower Cretaceous age was found to be a producing formation, and 2 fields and 1 new pool, all producing gas and condensate were discovered. E. N. T.

1755. Developments in West Texas and Southeastern New Mexico in 1946. R. L. Boss and W. J. Hilseweck. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1018–1038.—There were 2219 wells completed in 1946 in the area of West Texas and southeastern New Mexico; 1843 were in West Texas including 335 exploratory holes of which 123 were successful and 376 were in southeastern New Mexico including 67 exploratory holes, 15 of which were successful.

Pipeline runs in West Texas were 191·27 million brl in 1946, an increase of 9% over 1945. Pipeline runs in southeastern New Mexico were 36·34 million brl in 1946, a decrease of 1·5% from 1945.

Oil and gas production was discovered in Pennsylvanian limestone on the eastern platform and in the Midland basin; Mississippian limestone oil in the Midland basin, and Ellenburger oil on the eastern platform. Oil was also discovered in Lower Permian beds below 10,000 ft in the Delaware basin

The exploitation of the shallow Bowers sand reservoir of the Hobbs field, extensions to the Paddock and Drinkard Permian Pools, and the steady growth of the pre-Permian Brunson pool are the most outstanding developments. E. N. T.

1756. Unconformities to Play Major Rôle in Arkansas–North Louisiana Discoveries. M. T. Halbouty and C. Hardin. *Oil Wkly*, 31.3.47, **125** (5), 32; 7.4.47, **125** (6), 42; 14.4.47, **125** (7), 40.—East Texas and Delhi are due to truncation and overlap, and fields of this type are likely to be found in Arkansas and North Louisiana. The Tuscaloosa and Paluxy are truncated on the south flank of the Monroe uplift, and they are overlapped by the Clayton gas rock and the Midway shales to give the trap at Delhi and the associated fields. Delhi was discovered in 1944, and was followed by West Delhi and Big Creek. In the first two the basal Tuscaloosa and the Paluxy give the main oil. Big Creek produces from lenses higher in the marine Tuscaloosa. The three have a producing area about 15 miles long and 2 miles wide, with reserves exceeding 250,000,000 brl. Production is found at depths of 2900–3300 ft.

The truncated edge of the Tuscaloosa and Paluxy runs east from Delhi round the southeast flank of the Monroe uplift and the Sharkey Platform into Mississippi, and wildcatting has taken place along this trend. In this area truncation is from the Annona chalk down to the top of the Cotton Valley formation. There has also been wildcatting north and south of the Delhi area, and lenticular sand production has been found at southwest Delhi, South Big Creek, and Lamar.

Approximate Woodbine equivalents occur on the southeast flank of the Sabine uplift, and truncation may have given oil traps.

In Arkansas the Lower Cretaceous and Jurassic beds have been truncated along northwest–southwest lines and they are covered mainly by Upper Cretaceous. These deposits change in character to the south and southwest. The Smackover oolites and Cotton Valley sands may produce where truncated and possessing lateral closure provided by nosing. The Smackover has produced south of a major fault zone in southern Arkansas, and at Midway north of the faults. The Paluxy, Rodessa, and Sligo offer possibilities of commercial oil production in this area of South Arkansas and North Louisiana.

Much of the production from the south and west of the Caddo-Pine Island uplift comes from truncated Paluxy sands. Similar production may be found on the north and east flanks.

Maps and cross-sections are included. G. D. H.

1757. Developments in Louisiana Gulf Coast in 1946. G. F. Shepherd. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1078–1083.—The 684 completions in 1946 in South Louisiana showed an increase of 11·54% over 1945. 79 were wildcats, 15 of which discovered new fields, including Queen Bess Island, Jefferson Parish. Of the new fields, 8 are oil, 2 are dry gas, and 5 are gas-condensate.

On old producing structures, 513 new wells were completed and 92 old wells were plugged back from other formations or drilled deeper. 75 of the new wells were drilled as field wildcats, 22 resulted in the discovery of new sands or field extensions. 75% of the development wells were successful, with 113 dry and abandoned.

The Week's Island field was reclassified from a gas-distillate field to an oilfield. A major westward extension of Tuscaloosa sand production resulted from the Union Producing Company's Belgard No. 1 completion in Big Island field. World's record for deep production was established in Week's Island field through completion of Smith No. 1 at 13,763–13,778 ft. E. N. T.

1758. Oil Possibilities on the Gulf Coast Continental Shelf. J. S. Critz. *Oil Wkly*, 6.1.47, **124** (6), 17.—The continental shelf margin occurs where the depth of water is about 600 ft, and throughout the world the shelf area is about 10,000,000 square miles.

The shelf area off the Gulf Coast covers 56,000 square miles and extends as much as 125 miles out to sea. The commonest of the Gulf Coast oil structures are non-piercing salt domes. Some 30 structures have been indicated in geophysical studies of 5000 square miles of shelf with less than 30 ft of water.

The Gulf Coast salt is believed to be of early Upper Jurassic age. Plugs may occur out as far as the edge of the continental shelf.

The 4 main oil-bearing sedimentary groups are the Sparta–Wilcox (Eocene), Cockfield–Yegua (Eocene), Marginulina–Frio (Oligocene), and the Miocene. The most productive belt for each group is generally farther south the younger the age. Coastwards each group changes from fresh water to marine in facies, and best conditions for oil occurrence seem to be where fresh water and marine beds interfinger.

The Creole field, opened in 1938, is a mile offshore, and produces from the Miocene at depths of 5100 ft in water up to 25 ft deep. It has 7 wells and was located by seismograph. A salt dome has been confirmed by drilling at Coon Point. Similar confirmation was obtained at McFaddin Beach.

The small Sabine Pass field was discovered 9000 ft offshore.

Offshore leasing is discussed. Maps show the depth of water offshore and the producing areas near the coast.

A generalized cross-section is given, and a list of tests drilled in the Gulf of Mexico.

G. D. H.

1759. Gilbertown : Oil Outpost. W. B. Jones and W. McGlamery. *World Oil*, 1.9.47, **127** (1), 42.—Gilbertown lies on the northern flank of the Hatchetigbee anticline, and is Alabama's first oilfield. The field, discovered in 1944, is about 10 miles long and one to three locations wide. Eocene beds occur down to 2000 ft, and good sand bodies in the Wilcox group carry water.

The Upper Cretaceous comprises Selma, Eutaw, and Tuscaloosa. The Selma, 1100 ft thick, consists of chalk and marl. The Eutaw is composed of 450 ft of sandstones and sandy shales. It may be an oil source, and is productive. The 1100 ft of Tuscaloosa is divided into Upper Tuscaloosa (sandstones and shales), Marine section (glauconitic shales and sandstones), and Massive sand (sandstone with shale breaks).

There are two roughly parallel faults along most of the field, both downthrown to the north. The non-porous Selma is thrown against Eutaw sandstones. Faulting probably went on during deposition.

Wells produce from fracture zones in the Selma chalk and from the Eutaw at depths of 2500–3570 ft. The Eutaw has a porosity of about 32% and permeability of 100–178 mD. The oil gravity is 17°. West Gilbertown had produced 560,986 brl to the end of 1946, the East Gilbertown 58,292 brl. The total output of both fields to the end of May 1947 was 777,575 brl.

Tables list the wells in the Gilbertown fields, and contour maps show the structure.

G. D. H.

1760. Developments in Canada in 1946. F. L. Fournier. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 947–958.—The Viking–Kinsella gas field was considerably enlarged during 1946 and 3 new gas fields were discovered at Provost, Elk Point, and Pendant d'Oreille. The Lloydminster heavy-oil field was considerably extended with 3 new pool discoveries. This resulted in Saskatchewan moving into third place as an oil producer, following Alberta and Northwest Territories. A new oil pool of unknown extent was found in the South Princess area on the central Alberta plains.

A large area of semi-solid bitumen and richly impregnated bituminous sand was discovered in the Mildred–Ruth lakes area of the Athabaska district by the Dominion Government Department of Mines and Resources. A new oil and gas field was discovered during the year near Wallaceburg, Ontario. E. N. T.

1761. Dominion's Liquid Bitumen Find of Great Importance. C. O. Nickle. *Oil Wkly*, 3.2.47, **124** (10), 23 (*International Section*).—It is estimated that 400–500 million brl of liquid bitumen occur on the west side of the Mildred–Ruth lakes area in northern Alberta. The overburden is thin. About 2 square miles have been explored by boring on a ¼th-mile grid, and a greater area on ½-mile spacing. The thickness of bituminous sands ranges up to 220 ft. Interfingering with clay and shale occurs. 12–18% of bitumen is found in the sands. Interstratified with the sands are beds of

liquid bitumen a few in to 21 ft in thickness. A Lower Cretaceous origin is suggested for the bitumen, and it is believed to have been deposited with the sediments. There are some bitumen seeps. G. D. H.

1762. Extensive Exploration Programme Seen Following Imperial's Leduc Discovery. C. O. Nickle. *Oil Wkly*, 5.5.47, **125** (10), 36 (*International Section*).—Leduc 1, Canada, completed in February 1947 flowed 950 brl/day of 39°-gravity oil from the Devonian at 5029–5066 ft. Wetaskiwin 1, about 32 miles to the southeast, was abandoned in the Devonian at 6502 ft. 3 other wells are under way in the Leduc area.

The Leduc has led to leasing activity. The leasing changes are noted. Battle Lake 1, lsd 16 12-46-3 w5th, about 35 miles southwest of Leduc, has been spudded. G. D. H.

1763. Leduc Discovery Encourages Canada. Anon. *World Petrol.*, Sept. 1947, **18** (9), 70.—5700 acres have been proved at Leduc, and ultimate recoveries of about 10,000 brl/acre are predicted. Alberta produced 6,276,654 brl of oil in 1946, but the oil requirements of the three prairie provinces is about 15,000,000 brl/yr.

Leduc No. 1 obtained oil-saturated cores at 5029 ft in a porous part of the Devonian limestone, and the well " blew in " in February 1947. The second well found a second porous horizon at 5375–5415 ft, with water at the bottom. No. 3 found the producing horizon of No. 1 less attractive, and a good gas flow at 5176 ft; it was completed at 5313 ft, flowing by heads. No. 4 was completed in the deeper horizon. A fifth well was brought in in July.

All the wells are restricted to 175–200 brl/day because of transport difficulties.

Tests of buried Devonian strata are to be made at Looma, 20 miles east of Leduc, Morinville, 18 miles north of Edmonton, Pigeon Lake (southwest of Leduc), and Paddle River No. 1, 65 miles northwest of Edmonton. G. D. H.

1764. Major Canadian Development Seen in the Lloydminster Area. F. H. Edmunds. *Oil Wkly*, 6.1.47, **124** (6), 16 (*International Section*).—Between 1933 and 1940 18 wells (8 oil, 1 gas) were drilled in the Lloydminster area. 4 found oil in the Colony sand, but did not produce. In 1943 Sparky 1, 4 miles west of Lloydminster town, found oil, and a further 8 oil wells, 2 gas wells, and 1 dry hole were completed. 19 wells were drilled in 1945 (13 oil, 1 gas) and 45 in 1946 to mid-November (24 oil producers).

Production comes from the Lower Cretaceous at about 1850 ft. There is a broad north-northwest–south-southeast anticline. The Lower Cretaceous sands are alluvial plain deposits including sands and silts. There are three mains sands. 3 wells have entered the Devonian. The scattered proved areas total 1600 acres. Allowing a sand porosity of 20%, 10% of connate water, and a recovery factor of 25%, the reserves are placed at 11,200,000 brl.

The drilling is summarized in a table and there are brief notes on the field operations, oil, and markets. A map shows the structure. G. D. H.

1765. Alberta Spotlight on North Pinhorn Gas Field. G. M. Wilson. *Oil Wkly*, 3.2.47, **124** (10), 20 (*International Section*).—Producing depths at North Pinhorn, 20 miles southeast of Foremost, are 2000–2200 ft. 4 good dry gas wells have been completed in the Bow Island (Upper Cretaceous) sand in an area some 10 miles by 3 miles. The output is about 70,000 M.c.f./day. The discovery well, 8 miles south and a little west of Lake Pakowki, had an initial open-flow potential of 48,000 M.c.f./day. 2 dry wells have been drilled between North Pinhorn and Foremost, but a connexion between the two fields may exist. Gas shows occur in a 200-ft fine-grained sand in the Colorado marine shales and the best production comes from the top. The trap is thought to be stratigraphic rather than anticlinal.

Medicine Hat has a gas reserve of 150,000–300,000 million cu. ft. It covers 60,000 acres and was opened in 1890. Bow Island may have 20,000,000 M.c.f. There are several other gas-producing areas. Bow Island produces from the Bow Island sand. Medicine Hat from a higher sand in the Colorado group.

Viking and Kinsella appear to belong to a single reservoir covering about 300,000 acres. In the Brooks–Princess area a 23,000,000 cu. ft. gas well was completed in 1946.

Alberta's total gas reserves are believed to exceed 2,500,000,000 M.c.f.

G. D. H.

1766. Mississippian Rocks Along Alcan Highway. L. R. Laudon and C. J. Chronic. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1608–1618.—Mississippian rocks are exposed at many places along the Alcan Highway in northern British Columbia from Mile 381 along the Tetsa River northwestward beyond the Liard River crossing. They consist of gray, slabby, silty limestone beds rhythmically interbedded with soft silty calcareous shales. The upper part of the section becomes thin-bedded and on weathered exposures appears as dark green chert. Maximum sections approach 350 ft in thickness. Analysis of the fauna shows the abundant occurrence of *Dictyoclostus inflatus* var. *coloradoensis*, *Spirifer arkansanus*, *Marginifera adairensis*, *Leiorhynchus carboniferum*, and *Deltopecten batesvillensis*. This fauna is early Meramec in age and can be directly correlated with some part of the Calico Bluff section in Alaska and with the Moorefield formation of the Arkansas Ozark section. No faunas of Kinderhook or Osage age occur along the Alcan Highway. E. N. T.

1767. Gaspé Peninsula Wildcat Test Prepares to Spud. Anon. *World Oil*, 4.8.47, **126** (10), 28 (*International Section*).—Venture No. 1 was drilled on the crest of the Galt anticline. It is 2424 ft deep and had a show of oil at 1587 ft. No. 2 is to be drilled 2600 ft south-southeast of No. 1. 5 miles north of No. 1 a live oil seep occurs 350 ft below the top of a limestone which should occur at depth in the Galt anticline. G. D. H.

1768. Sun Abandons Second Test in Nova Scotia. Anon. *Oil Gas J.*, 13.9.47, **46** (19), 76.—A test 5 miles south of Amherst, Cumberland County, Nova Scotia, has been abandoned at 11,504 ft. G. D. H.

1769. Standard's West Taber Area Due for Activity. Anon. *Oil Wkly*, 5.5.47, **125** (10), 36 (*International Section*).—Taber Province, Canada, 63-15A SW lsd 6 15-9-17 w4th, initially produced 159 brl/day of 22–23°-gravity oil on a $\frac{1}{4}\frac{3}{2}$-in choke with a G.O.R. of about 500. It lies $\frac{1}{4}$ mile south of No. 65-15A. G. D. H.

1770. La Salina Area Old Colombia Prospect Now Being Revived. G. O. Ives. *Oil Wkly*, 3.2.47, **124** (10), 3 (*International Section*).—On the Las Monas prospect a number of wells have been drilled over a period of about 20 years. Last year La Salina 1 was completed for 75-brl/day. There are impressive active seeps in this area, which has a steeply folded northeast plunging faulted anticline. Cretaceous, Oligocene, and Miocene beds are exposed, the Cretaceous being upthrust.

The results of some of the early wells are briefly described. La Salina 1 produced from the Eocene. A second well is testing. G. D. H.

1771. Interesting Wildcat Developments Reported from Areas in Colombia. Anon. *Oil Wkly*, 23.6.47, **126** (4), 31.—49-K at Tibu found oil showings in the La Luna member of the Cretaceous. The La Luna was met at 7400 ft.

El Tablon 1 has Tertiary oil possibilities at about 7800 ft; a drill-stem test of a sand at 7095–7115 ft had given gas at 18,000 M.c.f./day. This well is believed to be on a faulted anticline.

Floresanto 10 is said to be still in Oligocene at 10,276 ft. G. D. H.

1772. Two Peru Wildcats Tests on Ucayali River Spudded. Anon. *World Oil*, 4.8.47, **126** (10), 27 (*International Section*).—A test at Puerto Oriente near Contamana is 800 ft deep. Another test has been spudded at Santa Clara, near Orellana. During the first half of 1947 Agua Caliente produced 52,626 brl/oil; the 1946 total was 89,236 brl. G. D. H.

1773. Colon Company Opens New Western Venezuela Field. Anon. *World Oil*, 7.7.47, **126** (6), 24 (*International Section*).—West Tarra 2 has been completed near the Colombian border. Production of 1500 ft/day of 41°-gravity oil on a $\frac{1}{4}$-in choke has been obtained from 8810–9173 ft. Later wells will test a Cretaceous limestone horizon at about 6800 ft, from which high-gravity oil flowed at 2000 brl/day. G. D. H.

1774. D'Arcy Crews Continue Great Britain's Oil Search. E. N. Tiratsoo. *Oil Wkly*, 3.2.47, **124** (10), 13 (*International Section*).—At the beginning of 1946 Britain had about 230 producing wells in the Eakring, Dukes Wood, Kelham Hills, and Caunton

fields. During 1945 and 1946 some licences were granted and others were abandoned. The Easter Pardovan 1 well was abandoned in the Lower Carboniferous at 3183 ft. Ellenthorpe 1 was drilled to 3598 ft on a concealed Carboniferous anticline. Whittington 1 was abandoned in Lower Carboniferous limestone at 3369 ft. Kirkleatham 2 and Hayton 1 were abandoned in Upper Carboniferous beds at 3091 ft and 3882 ft, respectively.

Chaldon Down 2 was completed in 1946 at 1793 ft, not having found oil or gas.

Considerable amounts of geophysical work were done in various areas in 1946.

G. D. H.

1775. Deep Production Sought as D'Arcy Continues Work in United Kingdom. Anon. *World Oil*, 7.7.47, **126** (6), 36 (*International Section*).—Drilling of Formby No. 1 has been resumed and 6494 ft has been reached. A test is under way at Perlethorpe, 6 miles north of Eakring. A new well is being drilled on the north flank of the Cousland anticline to test the gas reserves. G. D. H.

1776. Exploration Denmark Shows Little Oil. Anon. *Oil Wkly*, 6.1.47, **124** (6), 35 (*International Section*).—A well on the Island of Mors, Limfjord, has had some oil shows. G. D. H.

1777. Geology of Denmark. Anon. *World Oil*, 7.7.47, **126** (6), 23 (*International Section*).—Some 33,000 shallow water wells have been drilled in Denmark, and these provide geological data in this largely drift-covered country. A major fault crosses Bornholm and extends into Sweden. The throw may be 15,000–20,000 ft down to the southwest. Near the fault an oil show has recently been found at 6000 ft in a well at Falsterbo, Sweden.

Shallow domes occur in North Jutland. A test is to be made on a deep structure near Herning. G. D. H.

1778. France's Drilling Programme Rigs Busy in Southern Area. E. D. Lynton. *Oil Wkly*, 3.2.47, **124** (10), 16 (*International Section*).—A gas field has been opened at St. Marcet, and 1 well has pumped a little oil from a Jurassic dolomitic limestone at about 6000 ft. There are indications of a gas field on the Proupiary structure east of St. Marcet.

14 wells have been drilled at St. Marcet, and 11 are capable of production from a Cenomanian breccia at about 4920 ft. About 3,500,000 M.c.f. was produced in 1946. Wells have been sunk at St. Martory, Richou, Ausignac, and Plagne and Puymaurin.

In southwest France there has been drilling at Audignon (20 miles south of Mont-de-Marson), Bastennes–Gaujacq (15½ miles east of Dax), Garlin (20 miles north of Pau), and Tresiers (15½ miles east of Pamiers). Evidence of oil or bitumen was found at Bastennes–Guajacq and Garlin. In South-France in the Montpelier area La Gardiole 1, 9½ miles southwest of Montpelier, has had slight gas shows; La Vaunage 1, 6 miles west of Nîmes, had small gas shows. Wells are also being drilled at Quissac (25 miles north of Montpelier) and Durfort (6½ miles north of Quissac). The Durfort wells have shown gas.

Gabian, 12½ miles north of Beziers, is on a small anticline. 5 out of 60 wells produce from depths of about 490 ft. The field has given 186,250 brl of oil in 20 years, and now it gives about 90 brl/month with much fresh water. Production is from the Muschelkalk. G. D. H.

1779. German Field Reitbrook, Almost Ruined During War. J. B. Eby. *Oil Wkly*, 7.4.47, **125** (6), 15 (*International Section*).—The Reitbrook field, 10 miles southeast of Hamburg, is associated with a salt mass, the beds overlying which are much folded and faulted. In 1910 a water well encountered gas in the Lower Oligocene, and several other gas wells were drilled. After geophysical work a commercial oil well was completed in an Upper Cretaceous limestone in 1937.

Miocene to Cretaceous beds are present and the salt overhangs. The oil is 21·3° gravity. There are 45 flowing wells and 15 on artificial lift. The limestone porosity is about 25%, and the permeability 2 mD. The peak output was 2,500,078 brl in 1940; the output was 240,800 brl in 1945. Overproduction depleted the gas cap and caused premature water invasion. Repressuring was begun 1942, and the water-table was flattened out.

A Lower Eocene sand is now being developed.

A map shows the Reitbrook structure and a cross-section shows the complex faulting. An electric log and columnar section are included, and curves show the drilling and production history. G. D. H.

1780. Oil-Reserve Provinces of Middle East and Southern Soviet Russia. F. J. Fohs. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1372–1383.—The Persian Gulf geosyncline is the result of the pushing southwest of the Alpine arc of the Tauros–Zagros Mountains against the Arabian lobe of the Gondwanda shield, a stable block creating a great foredeep with more than 30,000 ft of sediments of Carboniferous to Recent beds, principally Cretaceous, Tertiary, and Pliocene in age. In this basin are numerous oil pools, principally in the Asmari limestone. There are 20 developed oil pools with 150 wells capable of an annual production of 1,600,000 brl, and much gas; in 1946 production was 720,000 brl. Northeast of the Zagros mountains and south of the Elburz mountains are one second-class and three third-class basins with undeveloped oil possibilities.

In southern U.S.S.R. is the Caspian Sea province consisting of three great east–west synclinal basins with beds from Devonian to Recent, but principally of Permian to Tertiary strata. The basins with extensions westward into Russian-controlled Balkan States and other undeveloped basins, with older beds, at the north, give Russia extensive oil reserves. However, 1946 production here was only 555,000 brl.

The Middle East has 975,000 square miles of oil-gas basins, two-thirds promising for first-class pools. Southern U.S.S.R., inclusive of Balkan areas, has 1,048,000 square miles of primary areas, and 93,000 square miles of secondary areas. Ultimate oil reserves of the Middle East and Russia may be estimated at 100 billion brl, and those of the U.S.A. at 50 billion brl. E. N. T.

1781. Oil Search in Palestine. E. Aschner. *World Petrol.*, Feb. 1947, **18** (2), 50.—Geological and geophysical work has indicated conditions favourable for oil occurrence in Negev, the Gaza sub-district, and the region round Jebel Uzdum. It is said that twenty-three more or less promising structures have been mapped in western Palestine, covering 1000 square miles, and of this area 300 square miles is promising for oil and gas occurrence, and 100 square miles especially promising.

The first well is located in the Gaza district. G. D. H.

1782. Tunisia Exploration. Anon. *Oil Wkly*, 7.4.47, **125** (6), 39 (*International Section*).—From 1931 to 1944 11 wildcats, totally 34,440 ft, were drilled on seven structures in Tunisia. G. D. H.

1783. Japanese Report Major Oil Discovery. Anon. *Oil Gas J.*, 20.9.47, **46** (2), 161.—A discovery, claimed to be Japan's largest oilfield, has been made near Tōshio on the northwest coast of Hokkaido. Previous production was on a small scale. G. D. H.

1784. Search for Oil in Nigeria. E. N. Tiratsoo. *Oil Wkly*, 3.2.47, **124** (10), 24 (*International Section*).—The west and central two-thirds of Nigeria consists of igneous rocks. The oldest known sediments are Cretaceous marine sandstones and shales, north, east, and south of the igneous rocks. Their thickness is about 15,000 ft, and they are folded. Tertiary marine clays and sands occur in the northwest and south.

Most exploratory work for oil has been in southern Nigeria, but no suitable structures have been described. Tar sands and oil seeps are found along the coast east of Lagos. G. D. H.

1785. Gold Coast Oil Prospects. E. N. Tiratsoo. *Oil Wkly*, 5.5.47, **125** (10), 24 (*International Section*).—Exploratory work is reported in the Gold Coast area, and during the past 40 years about a dozen tests have been drilled, frequently without adequate geological work. Traces of gas and oil were found.

Much of the Gold Coast territory consists of Archaean, but there is a belt of sediments about 20 miles wide on the coast, and this includes Devonian, Carboniferous, Cretaceous, and Tertiary beds. The Cretaceous comprises over 4000 ft of sandy and clayey deposits, with occasional limestone bands. A geological map shows the distribution of the formations. G. D. H.

1786. Search for Oil in Northwest India. E. N. Tiratsoo. *Oil Wkly*, 5.5.47, **125** (10), 10 (*International Section*).—The first tests for oil in the Punjab were drilled in 1866. At times up to 1915 small amounts of oil were found, but that year gave the first important discovery at Khaur. The Dhulian field was brought into full production only in 1937. Other structures have been tested including Khabakhi, Gobhir, Jhatla, and Chorlakki.

The Upper Tertiary beds are wholly freshwater, but the Eocene, below an unconformity, is largely marine. All oil found thus far has been in the Miocene Murree sandstones or in Middle Eocene limestones. It is believed that the source rocks are in the Eocene.

The folds run roughly east–west and are tight and long. Seepages occur in the foothills of the Margala and Kala Chitta ranges, on the north flank of the Salt Range and at Khaur. The Khaur fold is slightly asymmetric and trends east-northeast–west-southwest. The productive area is about 100 acres. Some 350 wells have been drilled. Production was obtained in very shallow horizons in the Murree and later in the Eocene. The peak output was 500,000 brl in 1929. Dhulian is 10 miles southwest of Khaur, and is broader with the north flank steeper than the south flank. The field covers 900 acres, and there are 35 flowing wells. 36·8° oil comes from the Eocene at depths of about 7000 ft. The present output is 700 brl/day. Joya Mair lies 25 miles south of Khaur and the fold has a steep south flank. Heavy oil was found at a depth of 6896 ft in Eocene limestone in 1944, and a flow of 9000 brl/day followed. Carboniferous has been met below the Eocene, and this shows oil. Joya Mair's potentialities are pot yet determined. 12 miles west of Joya Mair is Balkassar, and there oil was found in 1946 in Eocene limestone at a depth of 8200 ft. The initial production was 350 brl/day. Further testing is needed. Maps and cross-sections are included.

G. D. H.

1787. Japan's Production Decline. Anon. *World Oil*, 1.9.47, **127** (1), 18 (*International Section*).—During the 1946–47 fiscal year Japan's oil production was 1,322,441 brl; the previous year's output was 1,482,578 brl. The country's proved and developed reserve is now slightly over 15,000,000 brl, and its cumulative production about 90,000,000 brl.

Recent studies in northwestern Honshu suggest that reserves in the sedimentary basins containing the Niigata and Akita oilfields may be 88,000,000 brl, with possible additional reserves in the basal Miocene below the present producing horizons. In the Hokkaido fields, which are virtually non-commercial, no tests have been made in the Paleocene and Cretaceous, which formations are oil-bearing at outcrop. Seeps occur in a large Tertiary basin in eastern Hokkaido, and there are Tertiary embayments on the Pacific coast of Honshu. Petroleum exploration in Japan has been found to be rather backward in development.

The history of oilfield development in Japan is briefly described. The output peak was between 2,830,500 brl and 2,956,300 brl/year in the period 1915 to 1917. About 76 fields are known, about half being abandoned. None is more than 1000 acres in extent or had reserves exceeding 18,000,000 brl. 10,272 wells have been drilled. Most fields seem to be of gas-depletion type, but Ishinazaka may be under strong water-drive. Less than 1% of the wells are flowing.

Brief notes are given on the more important areas, and there are comments on potential producing areas.

G. D. H.

1788. Petroleum Exploration and Production in Western Pacific During World War II. L. W. Stach. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1384–1403.—Production from Japanese concessions in North Sakhalin ceased at the Katangli field in 1939 and at the Okha field in 1943. Exploration practically stopped in Japan proper and Formosa during World War II, but was maintained in Manchuria. Exploration in both South and North Sakhalin ceased just prior to World War II. Intensive drilling and lack of exploration in Japan proper during World War II has left Japan with few undrilled reserves in sight; the Natural Resources Section of the Allied Powers has assisted the Japanese Government to develop a large exploration programme to find new reserves.

E. N. T.

1789. Geology of Roma District. F. Reeves. *Bull. Amer. Ass. Petrol. Geol.*, 1947, **31**, 1341–1371.—Since 1900, 40 wells have been drilled in southeastern Queensland,

Australia. Basement rocks in the vicinity of Roma underlay the surface at depths of 2000–4100 ft; oil and gas showings were found slightly above the basement rocks in non-marine formations thought to be Jurassic. In 1934 and 1935 geological work and exploratory drilling was undertaken and two or three promising structures were outlined. Three deep tests in the area were located on pronounced anticlines located 60–85 miles north of Roma. Gas was struck in two of the wells, but only slight showings of oil were encountered.

Geological investigations showed: (1) Well defined anticlinal folds in outcropping Permian strata 80–120 miles north of Roma. Slight unconformity exists between the Permian and Triassic, and a marked unconformity occurs at the base of the Upper Triassic; the folds in the Permian can be traced southeast in the mild folds of the Triassic, but disappear in the gently southerly tilt of the Jurassic strata; (2) The combined thickness of the Jurassic and Triassic is only 3500–5500 ft, and not 12,000 ft as formerly estimated. The Permian strata at the outcrop are only 5100–7000 ft thick; (3) The principal oil and gas showings at Roma were found in sandstones and grits of Triassic, not Jurassic age; (4) None of the 40 wells drilled in the region was located on an appreciable fold; (5) Gas encountered in the Triassic near Roma and in the Permian at Arcadia probably originated from Permian Carbonaceous strata. Oil at Roma may come from marine strata that occur in the middle and lower Bowen series of Permian age. All strata below the thin mantle of Cretaceous in the vicinity of Roma are non-marine in origin. E. N. T.

Geophysics and Geochemical Prospecting.

1790. Modern Developments in Geophysical Prospecting. A. Van Weelden. *J. Inst. Petrol.*, 1947, **33**, 344–352. (*Inst. Petrol. Meeting, London*, Mar. 1947.)—No new methods have achieved prominence. Detection of oil by means of soil analyses, from telluric earth currents or by electronic devices has been tried, but all these methods require further research. Improvements have been made in established methods and in their application. The accuracy and ease of handling of gravimeters have been improved. In seismic recording apparatus automatic volume control enables an accurate record to be obtained with the first shot, also better quality and packing of explosives give max speeds of detonation.

Aerial magnetometer surveys render negligible the small local variations due to, say, a little magnetic sand or scattered pieces of metal which affect surface surveys, and in addition when carried out at varying heights permit the separation of shallow and deep anomalies by comparison. The techniques used in submarine gravity meter and seismic explorations are discussed. A. R. W. B.

1791. Geophysical Principles for Determining Subsurface Conditions. R. M. Tripp. *Oil Wkly*, 9.6.47, **126** (2), 34.—Suppose that methane saturated with water vapour migrates through the crust along the path of maximum thermal gradient and maximum pressure gradient, and that it obeys Boyle's laws. The movement is probably described approximately by a modification of D'Arcy's equation:—

$$Q = \frac{KA}{\eta(1+m)L} P_1^{1+m} - P_a^{1+m}.),$$

where Q = flow in cc/sec; K = permeability (darcies); A = cross-section of area of flow (mm²); η = gas viscosity (poises); m = ratio of specific heats of gas at constant volume and constant temperature; P_1 = reservoir pressure (atmos); P_a = partial pressure of gas at surface. For a rock cover of 4500 ft with a permeability of 10^{-7} darcy, a reservoir under hydrostatic pressure and $m = 0{\cdot}86$, $Q = 4000$ moles/acre/year.

It has been estimated that in passage to the surface the net vaporization per mole of methane is $3{\cdot}92 \times 10^{-3}$ lb of water. Much of the loss of 25,000 cu. ft. of water vapour/acre/year is deemed to take place in the zone within 25 ft of the surface, and so may give rise to features not present in surrounding areas. Thus precipitation of slightly soluble substances might occur, and radioactive substances belong to this category Moreover, radioactive compounds cause changes in escaping hydrocarbon gases, giving paraffinic liquids and solids.

Thus the examination of soils for radioactivity and mineral wax may be a guide to oil discovery, especially if anomalies in the occurrence of both types of material coincide. G. D. H.

1792. Recent Trends in Geological–Geophysical Exploration and Methods of Improving Use of Geophysical Data. R. D. Coffin. *Petrol. Engr Reference Annual*, 1947, **18** (10), 47.—See Abstract No. 328 (1947).

1793. Geothermal Gradients in Mid-Continent and Gulf Coast Oilfields. E. A. Nichols. *Petrol. Engr Reference Annual*, 1947, **18** (10), 64.—See Abstract No. 941 (1947).

1794. Five Companies Join in Extensive Magnetometer Survey of the Bahamas. Anon. *Oil Wkly*, 21.4.47, **125** (8), 35.—50,000–80,000 square miles of the Bahamas banks are to be surveyed by airborne magnetometer in 8 months, for a cost of about $750,000. Location will be aided by Shoran, and should help in correcting maps rendered inaccurate, where based on astronomical observations, because of the presence of numerous gravity anomalies. G. D. H.

1795. Results Obtained by the Helicopter-Borne Magnetometer. H. Lundberg. *Canad. Min. metall. Bull.*, 1947, **50**, 592–600.—See Abstract No. 1381 (1947).

1796. Radar Proves Useful Tool in Marine Surveying. W. H. Wilson. *World Petrol.*, May 1947, **18** (5), 71.—Speed is essential in marine surveying for geophysical work, but this type of surveying need not attain the same degree of accuracy as is required for well locations. Triangulation from a base line on shore is commonly used for locating a point offshore. Questions of visibility put a limit on the range that can be reasonably reached by this visual method. Steps of 10–15 miles outwards might be possible by establishing subsidiary marine stations, but this technique would be costly.

Radar can be applied in marine surveying. Some equipment has a range accuracy with a probable error of ±20 yd. Elevated targets and antenna will be necessary to cover relatively great distances. In stepping outwards with the radar technique, existing channel buoys or lighthouses can be used as intermediate points or temporary buoys may be anchored. In this case using a pair of targets distances only need to be measured. For this purpose radar equipment designed as a navigational aid for shipping can be employed. Shoran has also been successfully applied in marine surveying, and again an accuracy of the order of ±20 yd in range has been claimed. The sextant and wire line prove valuable in making measurements over shorter distances, as between buoys marking subsidiary stations. Wire line measurements of a distance three miles in length probably had an accuracy of ±60 yd. The wire can be paid-out or taken-in at speeds up to 9 m.p.h. G. D. H.

1797. Radiographic Methods of Geophysical Exploration. M. A. Blackburn. *World Oil*, 11.8.47, **126** (11), 43.—The radiographic method of geophysical surveying depends on measuring radio field intensities by automatic recording. These records can be made in a car travelling at speeds up to about 50 m.p.h. and iso-intensity contour maps can be constructed. Faults can be detected and the direction of the axis of a structure has been determined, together with a measure of the relief, but not the depth.

A special sensitive radio receiver was connected to an Esterline–Angus recording meter and intensity measurements were made on standard broadcasting stations.

Observations can be substantially duplicated. It has been possible to correlate radiographic anomalies with known subsurface anomalies, and they could be explained by secondary fields interfering with the primary field, reflection and refraction of the primary field.

Near-surface sediments overlying oilfields have measurably different physical and chemical properties from equivalent beds away from the producing area. These differences may modify radio intensities. G. D. H.

1798. Modern Seismic Techniques Applied to Geophysical Exploration in West Texas. S. Harris. *Oil Gas J.*, 19.7.47, **46** (11), 60.—See Abstract No. 1158 (1947).

1799. Torsion Balance Surveys of Inundated Areas. K. H. Hasselmann. *World Oil*, 21.7.47, **126** (8), 38.—A tripod is employed to support the torsion balance, and this is surrounded by a float which prevents waves striking the tripod, and also carries equipment and personnel. The float is anchored.

The stations are previously marked and surveyed. The move from one station to another required about 1½ hr; the reading period was 8 hr. Water 5–50 ft in depth was suitable for using this equipment. Generally no terrain corrections were needed.

G. D. H.

1800. Some Practical Considerations of Radioactivity Well Logging. J. M. Walker and S. W. McGaha. *Oil Wkly*, 6.1.47, **124** (6), 33.—Equipment must be provided to suspend the logging equipment over the well head. A lubricator is necessary where high pressures occur. The casing programme should be known and also the metal in the casing. Similarly it is essential to know if plastic has been used for cementing. Enlarged holes due to shooting affect the logs.

Standard logs are 2 in to 100 ft, but 5 in to 100 ft can be made. G. D. H.

Drilling.

1801. Standard Equipment in Squeeze Cementing at Record Depth. H. David. *Oil Gas J.*, 27.9.47, **46** (21), 94.—The equipment used and details of operation of a squeeze cementing job at 16,274 ft are fully described. The bottom-hole conditions and pertinent facts of other cementing jobs at various depths by the same method, are given. C. G. W.

1802. Prefabricated Offshore Drilling Platform Set Up in Record Time. E. H. Short, Jr. *Oil Gas J.*, 9.8.47, **46** (14), 82.—The drilling structure consists of 6 templates. These were towed on barges and set on the ocean floor. Piles are driven through the hollow vertical members after the frame has been located. Time taken was only 9 days compared with a period of several months for completing platforms of conventional type; also the prefabricated templates cross-braced from top to bottom gives a platform of greater rigidity than the old method, where the structure was braced only above water. C. G. W.

1803. Drilling Equipment Records. M. Hart. *Petrol. Engr Reference Annual*, 1947, **18** (10), 68.—Various methods of keeping drilling equipment records are described.

R. B. S.

1804. Rolling Heavy Rigs on Wheels. G. Weber. *Oil Gas J.*, 2.8.47, **46** (13), 58.—The rig is highly unitized for rapid movement in several loads. The engine unit, mounted on two heavy water drums is skidded away from the derrick and wheeled as a single load. Draw-works and engine shed are guyed to the derrick and then moved intact. The rig-moving equipment consists of 4 four-wheeled dollies placed under the derrick corners or engine unit supports. Estimated time saving on moving to a new location is 2 days. C. G. W.

1805. Deep Cable-Tool Drilling in Appalachian Area. H. W. Haupt. *Petrol. Engr Reference Annual*, 1947, **18** (10), 72.—The methods of overcoming the hazards involved in cable-tool drilling in the Appalachian area are discussed. R. B. S.

1806. Deep Rotary Drilling Applied to Appalachians. B. R. Miller. *Petrol. Engr Reference Annual*, 1947, **18** (10), 75.—See Abstract No. 1030 (1946).

1807. Separate Cooling on Drilling Rigs. Anon. *Oil Gas J.*, 13.9.47, **46** (19), 99.—The advantages of remote-type jacket water coolers over engine mounted radiators, are outlined. Such advantages are (1) Power saving in fan loads. (2) Removal of heat from the rig. (3) Reduction in noise near the rig. The principal disadvantage is that the coolers constitute a separate piece of equipment to be moved with the drilling rig. Also the overall cost of coolers is a factor to be considered. C. G. W.

1808. True Resistivity Determinations from the Electric Log. H. G. Doll, J. C. LeGrand, and E. F. Stratton. *Oil Gas J.*, 20.9.47, **46** (20), 297.—The electric log gives two electrical parameters of geological formations—spontaneous, potential, and resistivity. Electrode devices in common use and general procedure are discussed. The general case for a resistivity measurement is that of three media, well fluid, invaded formation, and virgin formation, the resistivities being *Rm*, *Ri*, and *Rr* respectively. The apparent resistivity *Ra* as measured, is a function of these three resistivities and electrode spacing. Equations for these resistivities and diagrams showing the variation of apparent resistivity with electrode spacing given for both two and three media cases. In order to correlate between apparent and true resistivities resistivity departure curves have been established for the two media cases. These are plots of the ratio *Ra*/*Rm* against electrode spacing/well diameter for various values of the ratio *Rr*/*Rm*. These curves extrapolate to an asymptote at a value *Ra*/*Rm* = *Rr*/*Rm*. In the three media case, groups of curves are plotted representing the value of *Ra*/*Rm* for different electrode spacings. Each plot corresponds to a certain value of the ratio *Ri*/*Rm*, each group consisting of several curves corresponding to different diameters of contamination for a given ratio *Ri*/*Rm*. Mud invasion tends to decrease the range of variation of apparent resistivities measured opposite beds of different true resistivities. Knowing true resistivity, hole diameter, electrode spacings, and apparent resistivities for several electrode devices, a section of curve can be plotted on the chart representing the resistivity departure curves. The true resistivity is then obtained by interpolation. It is necessary to have at least two and preferably three apparent resistivity values where invasion is suspected. Examples of the application of true resistivity determinations in log analysis are given. C. G. W.

1809. Testing of Drilling Fluids. G. R. Gray. *Petrol. Engr Reference Annual*, 1947, **18** (10), 100. (*Paper presented at Drilling Fluids Conference, Texas, A. and M. College, College Station, Texas*, May 1946.)—The tests that are normally used in determining the physical properties of a drilling mud are discussed. The instruments described in this connexion are: (1) the Mudwate Hydrometer; (2) the Mud Balance; (3) the Marsh Funnel Viscosimeter; (4) the Stormer Viscosimeter; (5) the Shearometer; (6) the Filter Press; and (7) the Glass-Electrode pH Meter; methods of testing for sand content, salt content, soap hardness, and pH by colorimetric means are also described. Ten references are appended. R. B. S.

1810. Selection of Mud Fluid for Completion of Wells. H. E. Radford. *World Oil*, 14.7.47, **126** (7), 36. (*Paper presented before Pacific Coast District Division of Production, A.P.I., Los Angeles*, May 1947.)—See Abstract No. 1400 (1947).

1811. Free Pump Speeds Drilling and Seating. G. M. Wilson. *World Oil*, 28.7.47, **126** (9), 81.—A description is given of a new hydraulic type of pumping unit, known as the free pump. The free pump is similar to a conventional type of hydraulic pump, the main differences in this type of unit being in the method of installation and in the arrangement of tubing macaroni strings in the well. The free-pump type of installation enables the pumping unit to be seated in the well and brought back to the surface by hydraulic pressure, thus eliminating the necessity of installing conventional pulling equipment and other tools. R. B. S.

Production.

1812. Marble Shooting. J. G. Burch. *Petrol. Engr Reference Annual*, 1947, **18** (10), 114.—See Abstract No. 34 (1946).

1813. Decline Curves. E. R. Lloyd. *World Oil*, 21.7.47, **126** (8), 34.—The author discusses the decline curve equations developed by the late T. H. Olds and compares them with other decline curve equations. Olds' equation was a hyperbolic one, so that the rate–time curve plotted on log–log paper had a constant slope (*i.e.*, was a straight line). The following equations for rate of production and ultimate recovery can be developed from Olds' equation:

$$y = \left(\frac{C}{x}\right)^{1/n} \qquad A = \frac{Cn}{1-n} y^{(1-n)}$$

where y = rate of production at any time x in years of the well's life, and A = future production (as between the time when the rate of production is equal to y and the time when the rate of production reaches zero. The values of n and C are constant for a given rate–time decline curve. The equation for future production from a given rate to an assumed economic limit is

$$A - A_{EL} = ky^{(1-n)} - ky_{EL}^{(1-n)}$$

when $k = \frac{Cn}{1-n}$ and A_{EL}, y_{EL} are values corresponding to the economic limit of production rate. An equation can be developed for cumulative production at any time in a similar manner by calculating the gross future corresponding to the initial rate of production, and the future corresponding to the rate at the given time.

In comparing Olds' equations with those developed by J. J. Arps, the author shows that they are fundamentally the same as Arps' equations. The exponential type of curve developed by several other technologists is simpler to handle, but is also less accurate under certain conditions. With decrease in the value of n in Olds' curves the hyperbolic type approach the exponential type: for values of n less than 0·10 there would be little error involved in using exponential curves. In general the use of exponential curves gives estimates of future production that are too low.

Three references are appended. R. B. S.

1814. Determination of Stresses in Oil-Well Casing in Place. C. H. Oberg and R. W. Masters. *Petrol. Engr*, June 1947, **18** (9), 149.—A description is given of a method for determining the changes in stress in oil-well casing after being placed in the well and whilst being affected by the varying temperatures and pressures encountered during drilling and producing operations. The results of field tests are discussed, and the importance of using the proper casing landing tension is stressed. R. B. S.

1815. Remedial Work on Dually Completed Wells. R. Williams. *Oil Gas J.*, 13.9.47, **46** (19), 101.—Recently the necessity for killing wells and pulling tubing and packers has been avoided. In one case, the upper of two producing formations had ceased to flow because of water intrusion and it was decided to produce the upper formation by gas lift. In most dually completed wells the upper zone is produced through an annulus of tubing and casing with a packer sealing the annulus between producing zones. The lower zone flows through the tubing. A string of 1-in pipe with a packer is run inside the 2-in tubing and gas injected from the annulus of 1-in and 2-in strings into the annulus of tubing and casing through an orifice button in the tubing wall above the packer. The lower zone is produced through the 1-in string. In another case, it was apparent that there was a leak between zones, and it was decided to test for a tubing leak before killing the well and pulling tubing and packer. To test the tubing, a plug was placed at packer depth and with casing closed in at the surface the build-up of pressure in the tubing indicated a leak in the string. To locate the tubing leak an Otis extractor tool was placed directly above packer level. The casing was then opened and the well flowed at a high rate to lower the pressure in the annulus which lowers the pressure in the tubing, causing the extractor tool to be pushed up to the tubing leak by flow from the lower zone. A measuring line is run to give the location of the leak. The leak was sealed by an 8-ft length of 1-in pipe with sealing cups at top and bottom. C. G. W.

1816. Corrosion and Preventative Methods in Katy Field. R. C. Buchan. *Petrol. Engr Reference Annual*, 1947, **18** (10), 159.—See Abstract No. 346 (1947).

1817. Economics of Cycling. Part I. W. H. Woods. *Oil Gas J.*, 16.8.47, **46** (15), 89.—Cycling is defined as a method of producing gas-condensate reservoirs for their liquid content. The characteristics of such reservoirs and the development of cycling are discussed. The evaluation of capacities of gas condensate reservoirs by (1) a volumetric method, (2) a pressure decline method is outlined. C. G. W.

1818. Economics of Cycling. Part II. W. H. Woods. *Oil Gas J.*, 23.8.47, **46** (16), 99.—Recovery from gas-condensate reservoirs depends on the type of drive. Water-drive theoretically gives 100% recovery, but in practice a small pressure drop occurs

causing loss by retrograde condensation. In the case of gas drive the remaining gas has to expand to replace gas and condensate produced. Losses by retrograde condensation depend on the pressure drop between virgin pressure and final pressure and may be calculated from a plot of condensate yield *a v* reservoir pressure. In cycling operations loss of liquids is a function of pressure drop, which is due to (1) shrinkage or extraction loss; (2) fuel requirements; (3) deviation factor difference between reservoir gas and dry gas. Injection rates may be maintained by make-up gas. Losses during cycling are due to retrograde condensation and by-passing of wet gas. By-passing may be due to (1) inefficiency in cycling pattern; (2) variation in permeability throughout the reservoir. Evaluation of by-pass losses is discussed and a comparison of recovery by straight production and by cycling made. Recoveries are estimated at 27·7% for condensate and 35% for crude by straight recovery as against 81·8% and 50% by cycling. C. G. W.

1819. Pseudo-Critical Temperature of Gases. J. C. Calhoun. *Oil Gas J.*, 4.10.47, **46** (22), 103.—No. 302 in the *Engineering Fundamentals* series shows that there is no single value for critical temperature and pressure for a mixture of gases; pseudo-critical temperature and pressure figures being calculated for such mixtures. Two figures and a table are provided and an example worked out. G. A. C.

1820. Gas Condensate Reservoirs. O. F. Thornton. *Petrol. Engr Reference Annual*, 1947, **18** (10), 124.—See Abstract No. 370 (1947).

1821. Phantom Pumper Enables Remote Control of Wells and Tanks from a Centralised Panel. L. S. McCaslin. *Oil Gas J.*, 2.8.47, **46** (13), 60.—The remote-control system enables the operator to (1) open or close any one tank in a battery of tanks; (2) open or shut-in any one or all wells supplying oil to a chosen tank; (3) determine which tank is receiving oil at any time; (4) read the number of brl of oil delivered to a chosen tank; (5) keep a record of total production into a battery of tanks; (6) discern fluid levels in each tank; (7) automatic topping out of tanks at pre-selected levels.

A number of safety features are incorporated to prevent mishaps or loss of oil. Flow of oil is controlled by a gas diaphragm-operated valve. The supply of gas to the diaphragm is controlled by a three-way electrically operated gas valve. Liquid level gauging is done by a liquid level meter body connected to an indicator on the central control panel. C. G. W.

1822. Motors and Controls for Beam-Well Pumping. W. G. Taylor. *Oil Gas J.*, 13.9.47, **46** (19), 86.—Squirrel cage, three-phase induction motors are widely used for beam-well pumping. The three types are the normal torque, high-starting torque, and high-slip types. The factors governing selection and the conditions under which each type of motor is least used are discussed. The control unit includes a fused line switch, motor starting magnetic switch, an automatic time switch, a selector switch, and under-voltage and temperature-overload relays. Time-cycle pumping is used where production is prorated or where the well is pumped for only a few hours a day. The motor is started and shut off at predetermined intervals by the automatic time switch. C. G. W.

1823. Nitrogen as Repressuring Agent for Secondary Recovery. L. S. McCaslin, Jr. *Oil Gas J.*, 27.9.47, **46** (21), T2.—Nitrogen is used in the Silica field of Kansas because of the absence of cheap natural gas, and the large quantities of water produced preclude the use of air. The nitrogen is generated by burning filtered crude oil and scrubbing and compressing the combustion products to 1000 p.s.i. Details of the generator are given. The project is regarded as an experiment in reservoir mechanics and tests will be made measuring nitrogen used, and oil and water production of the wells in the area. C. G. W.

1824. Pumping Equipment Selection for Secondary Recovery Developments. E. N. Kemler. *Petrol. Engr Reference Annual*, 1947, **18** (10), 155.—See Abstract No. 357 (1947).

1825. Slime and Algæ Control in Oilfield Flood-Water. Anon. *World Oil*, 28.7.47, **126** (9), 88.—The fundamentals of detection and prevention of algæ formation are briefly discussed. R. B. S.

1826. Free Pumping Used in Hydraulic Drives. H. David. *Oil Gas J.*, 16.8.47, **46** (15), 94.—The free pump is an adaptation of the conventional hydraulic pump. Modifications are (1) a nose assembly carrying rubber packers to raise and lower the pump; (2) a four-way valve containing a catcher-head assembly installed at the surface. The purpose of this valve is to control the direction of circulation of fluid; (3) the shoe is modified to facilitate the pump seating above the standing valve. Two tubing strings, one for power oil and one for production, are connected at the well bottom by a shoe housing containing a standing valve. When the pump is inserted and the catcher-head assembly in position power oil is forced into the power tubing pushing the pump down. At bottom, the pump seats and seals in the valve shoe. During pumping operations the standing valve is held off its seat by a permanent magnet. To surface the pump it is only necessary to reverse the direction of circulation. When the pump reaches the surface it latches in the catcher-head assembly. Running and pulling time, paraffin control, and operating costs are also discussed. C. G. W.

Oilfield Development.

1827. Oil Weekly 1947 World Oil Atlas. Anon. *Oil Wkly*, 30.6.47, **126** (5), Section 2, 1–376.—In addition to information on oilfield development in countries throughout the world, many maps are presented for countries other than U.S.A., and data are given on demand and supply, petroleum possibilities, production and reserves, producing wells, completions and footage, refining facilities, and the principal oil companies outside the U.S.A. G. D. H.

1828. Small Firms Loom Big in Company Drilling. Anon. *World Oil*, 28.7.47, **126** (9), 72.—In the first half of 1947, 37 of the larger companies in the U.S.A. completed 27·7% of the new wells and 23·4% of the exploratory wells. These companies had 32·4% of the productive exploratory wells. The larger companies drilled 21·2% of the strict wildcats and gained 22·9% of the new field discoveries.

A table summarizes the results of the drilling in the first half of 1947 for some of the larger companies and for the rest of the industry. G. D. H.

1829. Shortages Hold Drilling to Moderate Increase. Anon. *World Oil*, 28.7.47, **126** (9), 65.—The drilling outlook in the principal producing States is briefly reviewed, and the outstanding features of the first half of 1947 are noted. G. D. H.

1830. History of Reserves and Production of Natural Gas and Natural Gas Liquids in Texas. P. Olcott. *Petrol. Engr Reference Annual*, 1947, **18** (10), 118.—See Abstract No. 80 (1947).

1831. Shell in Canada. Anon. *Oil Wkly*, 16.6.47, **126** (3), 29.—Stony Creek, New Brunswick, produced 28,584 brl of oil in 1946. Its oil reserves may be 150,000 brl and gas reserves 4,000,000 M.c.f. Shell exploration New Brunswick has acquired an interest in this area. G. D. H.

1832. Alberta–Saskatchewan Output Climbs after Five-year Drop. Anon. *World Oil*, 1.9.47, **127** (1), 34 (*International Section*).—A peak production of 29,770 brl/day was reached in Alberta–Saskatchewan in February 1942, Turner Valley giving 29,495 brl/day. During 1946 the daily average was 19,932 brl, with Turner Valley averaging 17,456 brl. In March 1947 the corresponding daily figures were 18,159 brl and 15,643 brl; in June they were 19,608 brl and 14,689 brl respectively. The Lloydminster–Lone Rock area is primarily responsible for the rise, the output in June being 2355 brl/day, and in 1946 584 brl/day. Leduc averaged 585 brl/day in June. Figures are given for other fields. G. D. H.

1833. Alberta Oil Industry in the Half Year. J. L. Irwin. *Petrol. Times*, 27.9.47, **51**, 950.—Details are given of oil production from the various Albertan oilfields during the first half of 1947. R. B. S.

1834. Barco Concession Colombia. G. O. Ives. *Oil Wkly*, 5.5.47, **125** (10), 4 (*International Section*).—Oil was found at Rio de Oro in the northeast of the Barco concession in 1920. Later Petrolea was opened and then Tibu. At the end of 1946 Tibu was giving 11,220 brl/day and the entire concession 20,769 brl/day. The concession has produced over 30,000,000 brl of oil.

Communications with this area are difficult. The history of the concession is briefly described. A 265-mile pipeline runs to the coast, and it has a capacity of 28,000 brl/day.

Rio de Oro has 13 wells, 8 being producers, but it has never been operated commercially. Petrolea is an asymmetrical anticline with 128 producers. There are 6 shallow Cretaceous producing horizons. The field covers 4250 acres. Gas/oil ratios average 375 cu. ft./brl. The oil gravity is 47° A.P.I. Cumulative production to March 1947 was 24,247,472 brl.

Tibu and Socuavo are domes on a single fold. The Tibu dome is now known as Tres Bocas. Most oil is obtained from the Tertiary. The sands are lenticular. 3 wells produce from the Cretaceous. Tertiary production is from depths of 4900–5400 ft. The Cretaceous production comes from the Tibu member of the Uribante just above the basement. Total closure may cover 30,000 acres, but the developed area at present is about 3000 acres. G. D. H.

1835. Peru Looks to Extensive Oil Development. J. E. Rasmuss. *World Petrol.*, Aug. 1947, **18** (8), 52.—Peru produced 12,468,126 brl of crude oil in 1946. Natural gasoline production was 1,041,407 brl. Peru's oil consumption is about 5,000,000 brl/yr. Relatively little of Peru's potential oil-bearing area has been developed.

A new oil law is being prepared and points in this are briefly noted. G. D. H.

1836. Venezuela's 1946 Production Reflects Rising World Demand. A. M. Sutton. *World Petrol.*, Jan. 1947, **18** (1), 44.—Venezuela produced 323,361,000 brl of oil in 1945, and the 1946 output is estimated to have been 391,482,000 brl. In 1946 Western Venezuela gave 269,655,000 brl (Bolivar Coastal fields 228,542,000 brl). The Jusepin–Santa Barbara–Travieso area produced 44,362,000 brl and Guara gave 31,435,000 brl. Details on the production by fields and companies are given for 1946, together with the cumulative production.

510 wells were drilled in the first 10 months of 1946, 304 being in Eastern Venezuela. 457 of the completions gave oil and 2 gas. Of 48 wildcats 8 were successful. Brief notes are given on the activities of the various companies during 1946. G. D. H.

1837. Venezuela Consolidates Production Position. G. O. Ives. *Oil Wkly*, 6.1.47, **124** (6), 3 (*International Section*).—During October 1946, Venezuela's output averaged 1,120,709 brl/day, and for the first 10 months of 1946 the total was 321,219,308 brl.

Recent drilling is reported to have added 100–200 million brl of recoverable reserves at Quiriquire. Eocene production has been found. The Nipa producing section is similar to that at West Guara and Guico. The Pelayo discovery is east of the Leona field.

Production from the Tucupita field has begun. The Mercedes field has 18 closed-in wells. Cretaceous production has been opened at La Paz and Mara. At West Tarra Cretaceous production of 2000 brl/day has been obtained.

Venezuelan oil output is approaching the limit of existing transport facilities. Additional pipelines are planned. Pressure maintenance is being undertaken or planned, in some areas in Eastern Venezuela. Plans have been made for the construction of a number of refineries. A new road is being constructed in central Guarico. G. D. H.

1838. Socony Expanding Venezuelan Operations. Anon. *World Petrol.*, Aug. 1947, **18** (8), 54.—Socony-Vacuum has built a 103-mile pipeline from West Guico to Guanta to handle increased oil output. The initial capacity is about 45,000 brl/day, but the addition of further pumps will raise it to 70,000 brl/day.

Socony opened the Guario field in 1940, and in 1946 the company's output was 8,108,000 brl. Guario has 18 producing wells on a single structure on the San Joaquin uplift. There are 13 oil sands and most wells are dual completions. Production is at depths of 5500–9500 ft. The oil is 43–44° A.P.I.

The Guico field (Guico, South Guico, West Guico, and West Nipa) produces 24,000 brl/day. The fields are much faulted. Production is under combined gas and water drive, and the 31 sands are at depths of 5500–7600 ft. The upper sands give oil of gravity above 40°, and the lower sands have oils down to 18° A.P.I. on gravity.

A little production has been found at Anaco in a well drilled to 11,294 ft. Gas has been found in a wildcat at Tascabana. G. D. H.

1839. Austrian Production Up But Still Under Pre-War. Anon. *Oil Wkly*, 14.4.47, **125** (7), 37.—Austria's oil outputs in 1944, 1945, and 1946 were respectively 8,219,288 brl, 3,076,304 brl, and 5,732,496 brl. G. D. H.

1840. Search Continues in Britain. E. L. Lomax. *World Petrol.*, Sept. 1947, **18** (9), 76.—The history of the search for oil in Britain is briefly described, and a short account is given of the general Eakring area, including drilling and completion, reservoir characteristics, analyses of the crudes, and the types of products obtained. Some indication of the areas still being investigated is given. G. D. H.

1841. Czechoslovakia Adopts Two-Year Plan in Effort to Meet Petroleum Needs. Anon. *Oil Wkly*, 6.1.47, **124** (6), 24 (*International Section*).—Currently the Czechoslovakian oil production is 16,248 brl/month. Miocene production has been found at Gross-Bilowitz near Breclav (Lundeburg). The initial flow was 50 brl/day from a depth of 3500 ft.

Gbely in western Slovakia was opened in 1913 and produces from shallow sand lenses in the Sarmatian at depths of 550–800 ft on a faulted structure. The faulted Hodonin anticline in south Moravia was discovered in 1919.

Tests are being drilled at Sekule, Malacky, and Bersky Svaty Jan in western Slovakia. Natural gas is being produced from wells in the Ostrava district, and there is a shallow gas pool at Vacenovice, Moravia.

A table gives the Czechoslovakian crude output monthly during the first 7 months of 1946. G. D. H.

1842. Czechoslovakia Output. Anon. *Oil Wkly*, 19.5.47, **125** (12), 29.—During 1946 Czechoslovakia produced 155,710 brl of oil. G. D. H.

1843. Pechelbronn Production Doubles Output of 1945. Anon. *Oil Wkly*, 14.4.47, **125** (7), 37.—During 1946 Pechelbronn produced 231,294 brl of oil. The 1945 figure was 105,644 brl.

21 producers, 6 dry holes, and 4 dry wildcats were completed on the Pechelbronn concession in 1940, and at the end of the year there were 707 producers. G. D. H.

1844. Exploitation of Natural Gas in the South of France. H. M. Ballande. *World Petrol.*, 1947, **18** (11), 40–41.—Production of natural gas is rising in spite of difficulties. At St. Marcet gasoline is stripped from the gas by gas oil. Fractionation of the hydrocarbons removed produces propane and butanes for bottling, motor fuel, and heavier fractions. An American plant (capacity 42×10^6 cu. ft/day, operating pressure 60 kg/cm^2) is to be erected to meet an expected demand of 25×10^6 cu. ft./day in 1948. Delivery of gas is by a pipeline supplying Pau and Toulouse and with a proposed extension to Bordeaux. Total length of existing lines is 136 miles. Electrolytic corrosion, due to the proximity of electric railways, is being combated by cathodic protection. E. B.

1845. Pressure at St. Marcet Field Given at 2000 p.s.i. Anon. *Oil Wkly*, 7.4.47, **125** (6), 36 (*International Section*).—2 oil wells, 9 gas wells, and 3 dry holes were completed in the St. Marcet (France) field in 1946. 1946 gas production was 3,880,000 M.c.f. and oil production 930 brl. G. D. H.

1846. Schoonebeek Field in the Netherlands. Anon. *Oil Wkly*, 2.6.47, **126** (1), 5 (*International Section*).—Schoonebeek (Coevorden) produces 2350 brl/day. It was discovered in 1943. The 1946 output was 435,420 brl, giving a cumulative production of 489,791 brl to January 1, 1947. G. D. H.

1847. Extended Operations Due West of Coevorden Field. Anon. *World Oil*, 21.7.47, **126** (8), 31.—At present Coevorden (Holland) produces about 3500 brl/day from 45 wells. The 1946 output was 436,000 brl. Drilling to the west and in the Wadden Islands is planned. G. D. H.

1848. Hungary 1946 Production Gains Slightly Over 1945. Anon. *Oil Wkly*, 7.4.47, **125** (6), 39.—In 1946 Hungary produced 5,145,342 brl of oil; the 1945 output was 5,020,695 brl. In 1946 Lovassi gave 3,029,931 brl, Budfapuszta 1,561,712 brl, and Hahot 552,699 brl. G. D. H.

1849. Roumania Hopes to Hike Monthly Oil Production. Anon. *World Oil*, 4.8.47, **126** (10), 24 (*International Section*).—Roumania's oil output averaged 2,600,000 brl/month in 1946 and 2,300,000 brl/month in the first quarter of 1947. A target of 3,286,750 brl/month has been set.

Promising discoveries are reported in the Semlak–Varjosul area near Arad, Transylvania, and elsewhere. G. D. H.

1850. Roumanian Oil Developments. E. A. Bell. *Petrol. Times*, 27.9.47, **51**, 949.—The post-war development of Roumanian oil production is briefly discussed: figures are also given for Roumanian petroleum exports in 1946. R. B. S.

1851. French Morocco Production Slightly Under 1945 Mark. Anon. *Oil Wkly*, 7.4.47, **125** (6), 39 (*International Section*).—French Morocco produced 19,700 brl of oil in 1946, and 23,603 brl in 1945. Tselfat gave 4500 brl in 1946, Ain-Hamra 8200 brl, and Bou Draa 7000 brl. 16 dry wildcats were completed in 1946, the total footage being 40,340 ft. G. D. H.

1852. Kuwait's 1946 Output. Anon. *Oil Wkly*, 7.4.47, **125** (6), 39 (*International Section*).—In 1946 Kuwait produced 5,931,000 brl of oil. G. D. H.

1853. Kansu Production Reported 1500 Gallons. Anon. *Oil Wkly*, 21.4.47, **125** (8), 35.—The Kansu province, China, production in 1946 averaged about 1500 gal/day. G. D. H.

1854. Yumen Completes 3 Wells, Taiwan 4, During 1946. Anon. *Oil Wkly*, 5.5.47, **125** (10), 38 (*International Section*).—During 1946 the Yumen field of China produced 512,810 brl of oil, together with 506,900 M.c.f. of gas. Szechuan gave 249,100 M.c.f. of gas and Taiwan 16,000 brl of oil and 1,370,000 M.c.f. of gas. G. D. H.

1855. Japan's Production Shows Decline 1946 Against 1945. Anon. *Oil Wkly*, 2.6.47, **126** (1), 26 (*International Section*).—Japan produced 1,543,893 brl of oil in 1945 and 1,342,229 brl in 1946. 95 wells (35 oil, 6 gas, 54 dry) were completed in 1946. G. D. H.

1856. Netherlands East Indies Fields Are Making Slow Progress Towards Recovery. Anon. *World Oil*, 4.8.47, **126** (10), 32 (*International Section*).—From 1943 to the end of the war the Japanese obtained over 30,000,000 brl/year from the Dutch East Indies and Borneo. During 1946 Borneo produced 2,010,000 brl and Java 90,000 brl. During 1947 the Dutch reoccupied territory has averaged about 192,000 brl/month.

Kroeka is again producing after extensive rehabilitation. Pangkalan, Brandan, Djambi, and Palembang in Sumatra and Tjepoe in Java are still in the hands of the Republic.

Early in 1947 the British Borneo output reached 41,000 brl/day. Seria (Brunei) and Miri (Sarawak) produced 2,100,000 brl in 1946. G. D. H.

1857. Tarakan's 1946 Production Tops Two Million Brl. Anon. *Oil Wkly*, 5.5.47, **125** (10), 40 (*International Section*).—In 1945 160,200 brl of oil and in 1946 2,312,300 brl was produced from Tarakan Island and Balikpapan, Borneo. G. D. H.

TRANSPORT AND STORAGE.

1858. Automatic Control on the Portland–Montreal Pipeline. C. D. Batchelder and R. A. Rockwell. *World Petrol.*, 1947, **18** (11), 52–55.—The 236-mile pipeline with its 8 pumping stations, handling crudes sent 2000 miles by sea prior to 1941, is now under an automatic control system based on series operation of the suction and discharge controllers. As the interlocking controllers operate the same valve, and because of the difficulty of skilled instrument service, they are without reset. The system is fully described and its advantages discussed. E. B.

1859. Pipeline Patrolling Now Made at 100 Miles per Hour. G. F. Leamon. *Pipe Line News*, June 1947, **19** (6), 17.—The author makes the following points: (1) There is a definite contrast between pipeline and surroundings and trained personnel have no difficulty in pin-pointing the line. (2) At an altitude of 300–400 ft no difficulty was experienced in locating and reporting troubles at speeds from 90 to 100 m.p.h. (3) The only delays encountered are occasioned by very poor visibility and ceilings, and are so infrequent as to be negligible. (3) Ground patrol checks show aerial patrols to be 90% accurate in locating leaks. (5) Aerial patrol covers a wider area on either side of the pipeline than a ground patrol. (6) Cost of an air patrol is approximately \$16.20 per mile. Cost of a ground patrol is approximately \$1 per mile. C. G. W.

1860. Use of Variable Capacity Plunger Pumps with Electric Motors for Pipelines. B. F. Thompson. *Pipe Line News*, May 1947, **19** (5), 10.—The pump, an Aldrich Goff variable stroke pump, is essentially a vertical triplex plunger pump. The crank shaft is connected to the plunger correcting-rods through an extra link and an extra cross-head. The extra cross-head is curved and may be tilted back and forth by an hydraulic piston. By varying the tilt any range of pump deliveries from zero to full capacity may be obtained.

Oil pressure to operate the hydraulic piston is provided by the lubricating oil-pump. High-pressure oil is admitted to either end of the piston through a 4-way valve which may be operated by a control device. Efficiencies of operation are high, approximately 85% at full plunger stroke, to 80% at half stroke and falling only to 65% at 25% of full stroke. Overall efficiencies of from 65% at half load to 78% at full load may be obtained.

This pump appears to have the flexibility of capacity and constant pressure of centrifugal pumps, and the high efficiency and low maintenance expense of reciprocating pumps. Sizes vary from 2 in to 6 in stroke and 10 h.p. to 100 h.p. maximum load. Pressures may vary from 15000 p.s.i., 500 p.s.i. being the lowest economical pressure. The largest unit gives a maximum delivery of 8500 brl/day at 565 p.s.i. The article gives the records of several installations of such pumps. C. G. W.

1861. Plantation Pipeline. Anon. *Pipe Line News*, July 1947, **19** (7), 9.—This all-electric system is 1261-miles long with 31 pumping stations and 17 delivery points. Total power required for all purposes is 55,000 h.p. Each station has 2 900-h.p. 2300-v explosion-proof motors connected to centrifugal pumps—3-stage on 12-in line, 4-stage on the 10-in line. Pumps operate at 3600 r.p.m. at 85% efficiency. Throughput is 100,000 brl/day of gasoline on 12-in line, 67,000 brl/day on 10-in line. Stations are designed for one-man control by means of electric and pneumatic controls. Switch from gasoline to tractor oil is made twice monthly. Many safety features are incorporated. All products are metered by rotocycle meters. C. G. W.

REFINERY OPERATIONS.

Refineries and Auxiliary Refinery Plant.

1862. Shell's Electric Dehydration Plant. Anon. *World Petrol.*, 1947, **18** (11), 47.—Operation of Shell's Petreco emulsion treating plant (24 units) at Lagunillas, Venezuela, is described. An A.C. (60 c.p.s.) field of 33,000 V, reduces the water content of crude oil (maintained at *ca.* 165° F) from 35% to 2%. Plant capacity is 6000 m^3 oil/day. E. B.

1863. Cooling Tower Performance Evaluated for the Plant Operator. II. J. G. Deflour. *Pipe Line News*, May 1947, **19** (5), 13.—Calculation of tower size merely entails obtaining the correct water concentration for one of chosen height which will operate under a certain wind velocity and wet bulb temperature. Area of a given height tower may be calculated by dividing gal/min by the concentration factor. Concentration required to produce desired cooling depends on: temperature range; approach to wet bulb temperature; tower height; wind velocity; and wet bulb temperature. The required concentration for a certain range and a certain approach to wet bulb temperature may be obtained from a chart and corrections applied from other charts for (1) tower height, (2) wind velocity, (3) wet bulb temperature.

The following formula may be used to calculate size of atmospheric cooling tower of effective width of 12 ft.

$$L = \frac{G.P.M. \times W}{C \times 12 \times Cw \times Ch}$$

where L = length of tower feet; $G.P.M.$ = gal of water/min; W = wind velocity correction; C = concentration of water/ft² of cooling tower area; Cw = wet bulb correction factor; Ch = tower height correction factor; several example calculations are presented. C. G. W.

1864. Heat Transfer at Low Temperatures Between Tube Walls and Gases in Turbulent Flow. T. A. Hall and P. H. Taso. *J. Roy. Soc. Arts*, 26.9.47, **191**, 6.—An apparatus was designed on the counter-flow system to study heat transfer between tube walls and gases at low temperatures in a region in which careful measurements had not been previously made. The apparatus consists of a counter-current heat exchanger insulated by a vacuum-jacketed copper tube, and fed with cold gas which is produced by boiling the liquid in a 7 gal steel generator. The effective length of the heat exchanger is 9 ft 3 in.

Oxygen, nitrogen, and carbon dioxide were used, covering a temperature range from +45° to −167° C, pressures up to 11 atm, and Reynolds numbers from 3000 to 60,000. Results were correlated by the use of dimensionless groups and a general equation obtained, independent of the nature of the gas and applicable over the whole range of experiments. With Reynolds numbers evaluated at mean film temperatures, the coefficient in the equation was found to be 5% lower than that obtained from measurements made at normal and high temperatures. This is regarded as justifying the extension of the ordinary equation to low-temperature regions. Tables give the heat-transfer data on oxygen, nitrogen, and carbon dioxide.

Determinations on friction accompanying heat transfer with gases in turbulent flow at low temperatures showed that the effect of heat transfer on the friction factor was small. G. A. C.

1865. Design of a Barrel-Drying Plant. P. H. Moore. *Petrol. Times*, 27.9.47, **51**, 946.—Details are given of the design and construction of a small barrel-drying plant which is of especial value in reconditioning previously used drums. R. B. S.

Cracking.

1866. Suspensoid Catalytic Cracking at Imperial Oil's Sarnia Refinery. C. H. Caesar, *Oil Gas J.*, 6.9.47, **46** (18), 69.—Suspenoid catalytic cracking operations over 6–7 years at Sarnia refinery has proved it to be a simple flexible and low cost process, very suitable for present day requirements, and particularly for small refineries. Its fundamental features are the very small amount of catalyst required (2–3 lb/brl feed), and as it is used in the form of a slurry with the feed stock, a conventional thermal cracking chamber can be used instead of a special reactor. The spent catalyst is separated from the product tars by filtering and may be regenerated. Used natural or activated clays from lub oil contacting are quite suitable and form inexpensive catalysts. Any type of feed stock, from naphtha to heavy gas oils can be processed in a single refinery unit, provided complete vaporization is attained in the heating coil. When operating with the heavier feed stocks it is better to add a carrying agent, *e.g.*, water, propane butane,

or naphtha. With naphtha the total yields are higher than would be obtained by separate operations, *i.e.*, gas oil by suspensoid cracking, and the naphtha by thermal reforming. Some data on refinery operations are given, which includes: (*a*) a comparison of thermal reforming with suspensoid cracking under normal and severe conditions, showing the yields without and including polymer gasoline production; and (*b*) suspensoid cracking of various source feed stocks. At coil temperatures of 1045–1055° F, and 350–450 p.s.i.g., an increase in feed rates, over former thermal cracking rates, still gives octane value of 8 A.S.T.M. (M.M.), and 11 C.R.F. (R.M), above those obtained by thermal operating. Maximum production of butylenes were obtained at 1080–1090° F with slightly lower feed rates, and the gasoline produced had higher octane numbers. If polymer gasoline is included in the scheme increased yields above those from thermal cracking are obtained of gasoline having octane numbers by the two methods, 9–12 and 12–16 points greater. Suspensoid cracking of feed stocks from four different crudes, in order of decreasing paraffinicity, at constant conversion of dry gas, shows that despite the wide distillation range the octane numbers of unleaded gasolines produced increased in the order of decreasing paraffinicity as measured by the characterization factor. Pilot plant operations with synthetic catalysts, and the effect of the feed source on refinery operations are discussed. Fresh 3-A catalysts compared with regenerated 3-A catalyst gave products with octane values only two points higher than with the regenerated catalyst, but the latter gave higher yields.

W. H. C.

Polymerization.

1867. Decomposition of Benzoyl Peroxide. I. The Kinetics and Stoicheiometry in Benzene. B. Barnett and W. E. Vaughan. *J. phys. & coll. Chem.*, 1947, **51**, 926.—The kinetics of the decomposition of benzoyl peroxide, which is used as a polymerization catalyst, is strictly first order only at infinite dilution. At all finite concentrations, the first order course is accompanied by a formally second order reaction. The system is studied particularly at 80° C when the second order reaction becomes the major decomposition path at initial peroxide concentration greater than 1·09 mol per kg of solution. Values of reaction velocity and activation energies for the two reactions are compared.

At 80° C the overall stoichiometry of the first order reaction consists chiefly of the formation of biphenyl and carbon dioxide, whereas that of the second order reaction moves according to the concentration of the peroxide. D. F. J.

1868. Decomposition of Benzoyl Peroxide. II. The Rates of Decomposition in Various Solvents. B. Barnett and W. E. Vaughan. *J. phys. & coll. Chem.*, 1947, **51**, 942.—At low concentrations, the decomposition of benzoyl peroxide in twenty-three different solvents is basically first order. The experimental result that the presence of 20% by volume of polymerizing styrene has little effect upon the rate of decomposition in benzene at temperatures up to 80° C, weakens the assumption of the existence of an equilibrium between benzoyl peroxide and benzoate radicals. There are indications that with many solvents, higher order reactions accompany a basic first order reaction, and that these solvents form hydroperoxides with benzoyl peroxide on decomposition in air or oxygen. D. F. J.

Chemical and Physical Refining.

1869. Aromatics from Petroleum. H. Steiner. *J. Inst. Petrol.*, 1947, **33**, 410.—Some general principles governing the formation of aromatics based on thermodynamics and quantum theory are reviewed. The formation of aromatics by dehydrogenation, cyclization, and isomerization is discussed. The hydroforming process makes use of all these reactions to produce toluene, xylenes, and generally high octane spirits. An alternative way of producing aromatics from petroleum is by cracking at high temperatures. The chemical reactions occurring in these processes are outlined, and a process recently developed in Great Britain to produce aromatics together with low molecular weight olefins, such as ethylene and propylene, is described. A. R. W. B.

Special Processes.

1870. Hydrocarbon Synthesis in the Presence of Cobalt Catalysts at Medium Pressures. C. C. Hall and S. L. Smith. *J. Inst. Petrol.*, 1947, **33**, 439.—An account of the more important laboratory-scale experiments carried out to study the performance of the active cobalt–thoria–magnesia catalysts in the Fischer–Tropsch synthesis at pressures of the order of 10 atm. A. R. W. B.

1871. Development of Hydrogenation and Fischer–Tropsch Processes in Germany. K. Gordon. *J. Inst. Petrol.*, 1947, **33**, 469.—Industrial methods for the production of synthesis gas, the hydrogenation of bituminous coals and coal-tars, and the operation of Fischer–Tropsch processes are reviewed. A. R. W. B.

1872. Chemicals from Petroleum and Natural Gas. G. Egloff. *Oil Gas J.*, 30.8.47, **46** (17), 88.—In the U.S.A., by 1942, 23% of all organic chemicals were derived from petroleum, amounting to 3,800,000,000 lb produced annually by some fifty manufacturers.

Hydrocarbons available for chemical processing range from methane to high molecular weight compounds obtained from natural gases, cracked gases, and liquid petroleum fractions.

Alkylation produces compounds suitable for chemical manufacture, as does catalytic dehydrogenation. Polymerization of olefins in cracked gas gives products from dimers to solid multipolymers, G.R.-S rubber being an example of the latter.

Oxygen, halogen, sulphur, and nitrogen compounds add to the number of products obtained from petroleum. 10,000,000 lb of cresols were produced in 1945 and three times as much naphthenic acids.

Oxidation of petroleum gases, liquids, and wax produces alcohols, aldehydes, ketones, and acids.

The Fischer–Tropsch process is being adapted to the production of hydrocarbons and oxygenated compounds from natural gas, and is estimated to produce 152,000,000 lb of alcohols, acids, ketones, and aldehydes annually.

Synthetic edible fats are produced from waxes.

Halogenation of petroleum products gives carbon tetrachloride, difluorodichloromethane, and ethyl chloride. Vinyl chloride (for plastics), thiokol rubber, and glycol are other typical products.

Glycerine can be produced from propylene; a $7,000,000 plant with an annual capacity of 35,000,000 lb is expected to start in 1948.

Many new insecticides are petroleum-derived halogen compounds. Pure sulphur is produced, one plant yielding 75,000 tons; and ammonia is synthesized from the hydrogen obtained from high-temperature cracking processes and nitrogen from liquid air fractionation.

Aliphatic nitriles are obtained from the direct reaction of olefins and ammonia.

Tables show yields of petrochemicals annually, composition of natural and cracked gases, and quantities of alcohols, aldehydes, acids, and ketones anticipated from the Fischer–Tropsch process. G. A. C.

Metering and Control.

1873. Capacitative-Commutator. S. A. Scherbatskoy, T. H. Gilmartin, and G. Swift. *Rev. sci. Instrum.*, 1947, **18** (6), 415–421.—This instrument has been developed to detect ionizing radiations in oil-well logging, but it can be adapted for measurement of minute currents in a high impedance circuit, such as occur in ionization chambers. The underlying principle is to shift the bands of frequencies representing the signal to a higher frequency region where the noise produced by the commutator itself is small, at the same time raising the energy level so that ordinary vacuum tubes of rugged design can be used to amplify the signal. To accomplish this, a D.C. signal is inverted into an A.C. signal by means of a vibrating condenser, which is formed by a fixed rigid plate and a reed caused to vibrate harmonically at fixed frequency by a magnetic driving circuit. Stability is obtained by the use of negative feedback, when the output current becomes almost independent of the amplification of the commutator and vacuum tube circuits, and response to rapid variations of the input is improved.

H. C. E.

1874. Instruments in Process Control. E. D. Mattix. *Oil Gas J.*, 23.8.47, **46** (16), 83.—Debutanizer design and performance and the different requirements of a debutanizer and a stabilizing column are discussed. Two groups of curves are shown which indicate liquid composition, and temperatures for each tray above and below the feed inlet, under three conditions of overhead rates when feed quality and rate are kept constant. These are supplemented by curves showing the effect of temperature on product composition on debutanizer tower: (1) overheads, and (2) bottoms; and a temperature–composition diagram for a *n*-butane and *n*-pentane system. From these data the functioning of debutanizers is discussed as to points at which control instruments are undesirable or useless, and those which provide the best performance. The control points and hook-up of debutanizers are shown in diagrams and are discussed, including a method of tying in the feed and temperature control to regulate the overhead product. The heart of this proportioning ratio system is a pneumatic multiplier. In operation any action by the temperature controller varies the multiplying factor in the relay which in turn changes the air pressure to the product–flow-controller index. Changes, either up or down, in product flow as demanded by the temperature instrument correct the temperature in the direction indicated because of the change in tray composition resulting from changes in product flow. W. H. C.

1875. Recorders and Controllers Shown at the Physical Society's Exhibition. K. M. Greenland. *J. sci. Instrum.*, 1947, **24** (6), 146–148.—Improved scales for thermal instruments are noted, and a brief description is given of a continuous-chart recorder for current indication. The friction between pen and paper is eliminated in a new electric barograph, and a visible yet photographic recorder used in conjunction with a galvanometer is mentioned.

Recorders for varying ranges of recording speed are referred to, some involving electronic amplification and cathode-ray tubes. Miscellaneous radio and electrical recording gear is noted, and ciné-camera applications are depicted. The utility and nature of various telemetering devices is described, and in some cases radio transmission is employed.

Advances in control technique are given, the accuracy and response being suited to a very wide range of plant and laboratory conditions, while several applications of the Magslip system for remote control or transmission of mechanical movement are detailed. C. N. T.

1876. A Sensitive Recording Calorimetric Mass Flowmeter. A. F. Brown and H. Kronberger. *J. Sci. Instrum.*, 1947, **24** (6), 151–155.—A recording calorimetric flowmeter making use of the thermal capacity of the gas is described and its theory given. Using a commercial pyrometric recorder, the flow corresponding to a full-scale deflection is about 5×10^{-6} g of hydrogen per sec. The instrument is, however, still linear to about twenty times the above value, the higher ranges being obtained by reducing the sensitivity of the recording instrument. The instrument is independent of pressure and, within limits, of temperature. The accuracy and stability is about ½%. The only part of the flowmeter in contact with the gas is a metal tube. (Authors' abstract.) C. N. T.

PRODUCTS.

Chemistry and Physics.

1877. A Relation Between Bond Order and Covalent Bond Distance. H. J. Bernstein. *J. Chem. Phys.*, 1947, **15**, 284–289.—The well known concept of bond order p, where p is zero for a single bond, one for a double bond, and two for a triple bond, is related to covalent bond distance. The relation is checked with experimental data including that on C–C, C–N, and C–O. The agreement is within the limits of experimental error. D. F. J.

1878. Infra-Red Spectra of Monomeric Formic Acid and Its Deuterated Forms. I. High Frequency Region. V. Z. Williams. *J. Chem. Phys.*, 1947, **15**, 232–242.—By replacing an atom in a molecule by its isotope, molecular dimensions are not appreciably changed, but new data pertaining to the same structure can be obtained. On this

principle the hydrogen and deuterium stretching vibrations of HCOOH, HCOOD, DCOOH, and DCOOD have been studied with a high resolution echelette—grating infra-red spectrometer. A brief account of the experimental technique, and direct photographic records of the absorption characteristics in the region 4000–2000 cm^{-1} are given. From previous data, assumptions of the hydrogen bond distances, molecular planarity and parameters calculated from the rotational structure of the bands, interatomic distances and angles are derived. D. F. J.

1879. Infra-Red Spectra of Monomeric Formic Acid and Its Deuterated Forms. II. Low Frequency Region. V. Z. Williams. *J. Chem. Phys.*, 1947, **15**, 243–251.—High resolution studies have been made of monomeric HCOOH, HCOOD, DCOOH, and DCOOD in the region 2200–800 cm^{-1}. The bands observed are not sufficiently regular in appearance or absorption frequency to permit assignment of vibrational modes, without further knowledge of the spectra. D. F. J.

1880. Dependence of Bond Order and Bond Energy Upon Bond Length. W. Gordy. *J. Chem. Phys.*, 1947, **15**, 305–310.—A simple inverse square relation of the form $N = aR^{-2} + b$, where N is the bond order, R the bond length, and a and b constants characteristic of the given pair of atoms, has been tested for several atomic pairs including C–C, C–O, C–N, and CB, and has given satisfactory agreement.

An equation of the form $E = lR^{-2} + m$, where E is the bond energy, and l and m constants, has been proposed, but because of the incompleteness and uncertainties in the available data on bond energies, no satisfactory test was possible. D. F. J.

1881. C–H Bond Energy in Toluene and Xylenes. M. Szwarc. *Nature*, 1947, **160** (4064), 403.—The pyrolysis of toluene and the three xylenes are shown to be homogeneous first order gas reactions, and the gaseous products are solely hydrogen and methane, except for slight amounts of ethane and ethylene in the case of *o*-xylene. The ratio of hydrogen to methane is the same under all conditions. The activation energies are *ca.* 76 k.-cal and the frequency factors of the order 10^{13}. On the basis of these observations the pyrolysis can be explained by a mechanism involving free radicals.

Assuming that the observed activation energy corresponds to the C–H bond strength, and taking the C–H bond strength in methane to be 102 k.-cal, the resonance energies of the benzyl and xylyl radicals can be calculated. They are considerably higher than the figure obtained for toluene from theoretical considerations. H. C. E.

1882. Dispersions in Non-Aqueous Media. J. L. Van Der Minne. *Ingenieur*, 17.10.47, **59** (42), Mk 83–88.—It is suggested that non-aqueous media can be divided into two groups: (*a*) methyl alcohol, ethyl alcohol, acetone, nitro benzene, and nitriles; (*b*) hydrocarbons, mineral oils, fatty oils, chlorinated hydrocarbons, and carbon disulphide.

The article is then divided into the following: (1) Coagulation and Peptization (*e.g.*, the use of calcium di*iso*propyl salicylate to peptize the "lacquer" formed by the oxidation of mineral oils used in motor engines); (2) Water as the Coagulant; (3) Sedimentation; (4) Bitumen, treated as a colloid consisting of a disperse phase of asphaltenes dispersed by maltenes; (5) Grease, consisting mainly of micro-crystalline soaps in mineral oil, and possessing plasticity and, to a small extent, elasticity. The rheological properties of greases are similar to those of lubricating oils possessing high molecular weights; (6) Suspension (*e.g.*, drilling mud).

The article is well illustrated with micro-photographs and it is the author's opinion that there is much fruitful work to be done in the colloidal chemistry of systems in non-aqueous media. D. H. J.

1883. Geometrical Configuration of Dialkyl Naphthenes. S. F. Birch and W. J. Oldham. *Nature*, 1947, **160** (4063), 368.—The only isomer of 1 : 3-dimethyl*cyclo*pentane (I) reported in the literature has been assigned the *trans*-configuration by analogy with 1 : 3-dimethyl*cyclo*hexane obtained by an asymmetric synthesis. Preparation of I from 1 : 3 : 5-xylenol gave rise, not to a mixture of *cis* and *trans* forms, but to a hydrocarbon with properties similar to those of the known isomer of I.

Attempted synthesis of the *cis* form of I, starting from *cyclo*pentane-*cis*-1 : 3-dicarboxylic acid, gave rise to the known form of I, and no evidence for the existence of a second isomer was found. This result is obtained either because at some stage in

the synthesis isomerization to the *trans* form occurs, or because the known form of I is in fact the *cis* form. In view of these facts synthesis of I from *cyclo*pentane-*trans*-1 : 3-dicarboxylic acid is being attempted. H. C. E.

1884. Application of a New Notation to Petroleum Hydrocarbons. G. M. Dyson. *J. Inst. Petrol.*, 1947, **33**, 356–362.—Details of a cipher system of nomenclature with particular reference to petroleum hydrocarbons are explained. Acyclic and alicyclic hydrocarbons are all delineated in terms of six symbols; chief advantages claimed for the system are that enumeration for each structure is defined in a unique fashion and that the notation is easily applicable to punched card manipulation. A number of examples are given. A. R. W. B.

1885. Naphthenic Acids : Boiling Points and Distribution in Gas Oil Distillates. K. F. Coles. *J. Inst. Petrol.*, 1947, **33**, 325–329.—The fractionation of a Trinidad gas oil at reduced pressure has enabled the distribution of naphthenic acids to be studied. It has been found that naphthenic acids with acid values 350 to 250 boil 60–40° C above the boiling points of the gas oil fractions in which they are found. The vapour pressure/temperature relationship for some naphthenic acid fractions is also presented. A. R. W. B.

1886. Oxidation of Olefins by Chromic Acid. A. Byers and W. J. Hickinbottom. *Nature*, 1947, **160** (4064), 402.—Oxidation by chromium trioxide in acetic anhydride of 2 : 4 : 4-trimethylpentene-1 (I) and 2 : 4 : 4-trimethylpentene-2 (II) yield large amounts of the epoxides, together with smaller amounts of the saturated ketones, aldehydes, and di-ols. The first stage in the reaction is the formation of the epoxide, which then produces the other compounds by further partial reaction. This mechanism explains the formation of 2 : 4 : 4-trimethyl pentanoic acid during the oxidation of I by chromic acid in aqueous sulphuric acid, since it is found that the epoxide, with aqueous sulphuric acid, rearranges to form the aldehyde, which is subsequently oxidized to the corresponding acid. Similarly, 2 : 2 : 3 : 3-tetramethyl butanoic acid has been detected in the oxidation products of technical di*iso*butylene, which contains about 20% of II.

The mechanism also explains certain anomalies recorded for the oxidation of olefins by chromic acid, notably that of acetic acid from ethylene, and saturated acids from di*neo*pentylethylene and octene. (See also Abstract No. 1188 (1947)). H. C. E.

1887. Entropy of Solution of Molecules of Different Size. J. H. Hildebrand. *J. Chem. Phys.*, 1947, **15**, 225–228.—The solutions considered are those of molecules of different size, whose shape is not specified, and which mix without heat effect and with maximum randomness. The entropy of mixing two liquids to make such a solution is expressed in terms which avoid the assumption of a lattice as an artificial frame of reference, and which is not limited to polymers. The equation is reduced to a similar form to that derived for linear polymers in a lattice frame of reference. D. F. J.

1888. Absorption Spectra of Benzene Derivatives in the Vacuum Ultra-Violet. I. W. C. Price and A. D. Walsh. *J. Roy. Soc. Arts*, 26.9.47, **191** 22.—New photographs of the far ultra-violet spectrum of benzene are presented. The absorption from 2000 to 1800 A. (λ max., *ca.* 1980 A) is regarded not as a part of the much stronger absorption of peak at 1790 A but as due to a separate transition. Sharp bands lying at 1790 A represent the first member of a previously reported Rydberg series.

The spectra of toluene, xylene, monochloro- and *o*-dichlorobenzene, bromobenzene, iodobenzene, and pyridine are briefly described, and the shifts relative to benzene are discussed. Two Rydberg series were observed for toluene, converging to a first ionization potential of $8{\cdot}77 \pm 0{\cdot}05$ V. G. A. C.

1889. Absorption Spectra of Benzene Derivatives in the Vacuum Ultra-Violet. II. A. D. Walsh. *J. Roy. Soc. Arts*, 26.9.47, **191**, 32.—The far ultra-violet spectra of styrene, α-methyl styrene, phenyl acetylene, phenyl cyanide, and phenyl *iso*cyanate are described. Many of the observed regions of absorption are correlated with those of the benzene spectrum. The important fact emerges that, with increasing conjugation of the side chain with the ring, the benzene 1980 A absorption moves much farther

to long wavelengths than do the benzene 2600 and 1790 A absorption. α-Methyl styrene shows a shift to the violet of certain regions of its spectrum relative to styrene. Phenyl *iso*cyanate has a spectrum much closer to that of benzene than have the other molecules discussed. G. A. C.

1890. Behaviour of Pure Substances Near the Critical Point. O. K. Rice. *J. Chem. Phys.*, 1947, **15**, 314–332.—There is evidence that the vapour–liquid region on the pressure–volume diagram of a pure substance is not bounded, as van der Waal's theory shows, by a parabola, but that it has a finite horizontal (const press) portion at the top. This upper limit is the highest temp, *Tm*, at which a meniscus can exist, and is assumed to be the temp at which the surface tension vanishes at the same time that the condition for equilibrium between liq and vap is fulfilled. The isotherms of ethylene have been plotted both with and without finite constant press sections above *Tm*, each diagram agreeing with the experimental results within experimental error. It is shown, however, that the latter is the correct interpretation, and that the critical temp should be defined as being identical with *Tm*.

The theory of condensation is developed by considering the vapour as a system in which molecules are associating into clusters, these obeying the ordinary laws of equilibrium. The liquid is considered as a system in which bubbles of vapour are forming. The conclusions are compared with those obtained using the statistical theory of Mayer and Harrison. D. F. J.

1891. Intermolecular Forces and Energies of Vaporization of Liquids. S. W. Benson. *J. Chem. Phys.*, 1947, **15**, 367–373.—It is calculated that the energy of vaporization of a liquid should be equal to the difference in configurational energies of the liquid and gas. The latter are expressed as functions of a single parameter, the density, and the equation simplified by assuming the density of a saturated gas to be small compared with the density of the liquid. The simplified equation is compared with experimental results for various compounds, including hydrocarbons, and good agreement obtained. D. F. J.

1892. Rheological Behaviour and Classification. F. H. Garner and A. H. Nissan. *Nature*, 1947, **160** (4062), 329.—The viscosity of a solution of aluminium stearate in petrol was determined at temperatures between 20 and 30° C: (*a*) by the falling sphere method, and (*b*) by means of B.S.I. U-tubes of different diameter. It was found that: (1) The viscosity by method (*b*) was smaller when a narrower tube was used; (2) The viscosity by method (*a*) was the same when balls of different diameter were used; (3) The viscosity by method (*a*) was greater than that determined by method (*b*). According to accepted nomenclature the system as studied by method (*a*) is Newtonian, and by method (*b*) is non-Newtonian.

It is proposed that rheological behaviour should be classified according to "regimes" rather than "ideal bodies," and this would also clarify properties such as yield values of materials under widely differing conditions of stress. The dangers of determining constants of systems by one method of measurement alone is also pointed out. H. C. E.

Analysis and Testing.

1893. The Chemical Aspects of the Petroleum Acts. S. G. Burgess. *J. Inst. Petrol.*, 1947, **33**, 363–387.—The author maintains that the Petroleum (Consolidation) Act of 1928 is an important contribution towards public safety, and traces the development of the present legislation and the parallel development of the flash-point apparatus from the first Act of 1862. The definitions and chemical aspects of the current Act are discussed together with the problems that arise from different interpretations. The general types and possible composition of statutory samples are enumerated, *e.g.*, cellulose lacquers, paint removers, and methods suggested for the separation of the petroleum, if any, from other substances that may be present. These methods are critically examined and attention is drawn to the difficulties of the interpretation of analytical data obtained in connexion with the examination and certification of samples taken under the Act. Complete details of the method recommended for the certifica-

tion of a typical sample containing saturated petroleum, namely, a cellulose spraying lacquer (Petroleum Mixture) are given as a conclusion to this critical examination of methods. A. R. W. B.

1894. Optical and Allied Instruments Shown at the Physical Society's Exhibition. J. L. Houghton. *J. sci. Instrum.*, 1947, **24** (6), 142–143.—Recent commercial equipment for phase-contrast-microscopy, an experimental projection microscope, a Schmidt camera and telescopes embodying the same principles, together with photographic equipment are described.

Surveying equipment, particularly the Williamson–Ross mapping system, is mentioned, emphasis being placed upon space conservation and speed of map preparation. Some notable attachments for visual education apparatus are referred to.

A modified Lovibond–Schofield colorimeter, adapted for colour measurements of cathode-ray screens and heterogeneously coloured samples, is mentioned, as are an optical surface-finish comparator and various stroboscopic lamps.

Two improved refractometers are noted, one a modified Pulfrich instrument, the other being of the Abbe type, with achromatizing prisms omitted, and an angular scale; measurements of refractive indices at a variety of wavelengths are therefore possible.

Besides a number of travelling microscopes, mention is also made of a combination of an infra-red spectroscope and cathode-ray tube whereby rapid delineations of infra-red absorption spectra are produced on the screen of the tube. Other items of miscellaneous interest are mentioned briefly. C. N. T.

1895. Thermal and Mechanical Instruments Shown at the Physical Society's Exhibition. C. R. Barber. *J. sci. Instrum.*, 1947, **24** (6), 144–145.—Various pyrometric instruments are described in some detail, including those for colour and brightness measurements for temperatures up to 650° C, an improved modified mercury-in-steel thermometer, and a high sensitivity recording resistance thermometer instrument. High temperature laboratory furnaces of two types are mentioned, and also an infra-red gas analyser, and various improvements in the hot-wire anemometer technique for the measurement of low air-speeds. Miscellaneous meteorological apparatus is noted.

A micromanometer and a newly developed flowmeter are mentioned, and reference is made to a modified quartz tube dilatometer; electrical strain gauges and various metrological instruments (*e.g.*, for measuring small diameters) are listed. C. N. T.

1896. Electrical and Acoustical Instruments Shown at the Physical Society's Exhibition. T. B. Rymer. *J. sci. Instrum.*, 1947, **24** (6), 148–151.—Although there are few or no fundamentally new instruments or techniques in this group, considerable improvement in detail is noted, giving rise to greater precision and finish. Centi- and deci-metric wave equipment, radio-equipment, moving coil meters, acoustic instruments, medical apparatus, and miscellaneous magnetometric instruments are described; pH-meters of the potentiometric and direct-reading types are noted and also a high-precision dielectric constant measuring instrument. C. N. T.

1897. Photoelectric Intensity of Raman Spectra. Jen-Yuan Chien and P. Bender. *J. Chem. Phys.*, 1947, **15**, 376–382.—The precision obtained with the apparatus described is tested by eight recorded spectrograms of $CHCl_3$, and the average deviation found to be $\pm 5\%$. When the ordinary photographic method is used the precision is about $\pm 14\%$.

Results are given for CCl_4, $CHCl_3$, CH_2Cl_2, and C_6H_6, and the intensity ratios of anti-Stokes to Stokes lines found to be in agreement with the theoretical values. Approximate values of the change of the bond polarizability of the C–C bond in CCl_4 and the C–H bond in C_6H_6 caused by valence vibrations are calculated from intensity data. D. F. J.

1898. A Raman Apparatus for Quantitative Polarization Measurements. B. L. Crawford, Jr. and W. Horwitz. *J. Chem. Phys.*, 1947, **15**, 268–274.—The description, data on the performance, and defects of an apparatus for quantitative measurement of the depolarization factors of Raman lines are given. Edsall and Wilson's method is modified by using polaroid cylinders, and by the incorporation of eight exciting lamps to shorten the exposure times. Results on the lines of CCl_4 are compared with those of other workers and additional results on $CHCl_3$ and C_6H_6 given. D. F. J.

1899. Studies of Aluminium Soaps. VIII. Water Sorption and Moisture Content. C. W. Shreve, H. H. Pomeroy, and K. J. Mysels. *J. phys. & coll. Chem.*, 1947, **51**, 963.—The aluminium disoaps obtained by acetone extraction of the dried precipitate from the double decomposition of potassium laurate and aluminium chloride are slightly hygroscopic, and traces of moisture have considerable effect upon the properties of the soap, especially its dispersion in hydrocarbons. The Karl Fischer Reagent should not be used for the moisture determination as water is formed either by reaction between fatty acids and basic aluminium soaps or from hydroxyl groups. The soap may readily be dried by evacuation, and then takes up only about 1% moisture in air at moderate humidities. D. F. J.

1900. The Mass Spectrometer and What it Does. C. J. Deegan. *Oil Gas J.*, 6.9.47, **46** (18), 64.—In this paper the author has recorded his concept of what takes place in a mass spectrometer, and the kind of record a hydrocarbon molecule gives. Mass spectrometer diagrams are given for methane, ethane, propane, *n*-butane, *iso*-butane, *n*-pentane, and *iso*-pentane. These show the various mass fragments into which the hydrocarbon molecule disintegrates when subjected to electronic bombardment as indicated by the height of the units (peaks) in μ divisions on the mass scale. The analysis of an unknown gas mixture from a mass spectrometer recording is illustrated in five diagrams, and shows the peaks for masses 15 upwards. In these are shown: (1) a peak at mass 72 which proves that pentanes are present; (2) after removal of proportionate units of other masses accounted for, first *iso*-pentane, and (3) *n*-pentane, units of 58 mass yet remain, proving butanes to be present. Repeating the process of removing proportionate units of masses 41 through to 58, (4) for first *iso*-butane, and then (5) *n*-butane, leaves a pattern that can only be due to pure propane. Statistical data from the analysis is given in tables: (1) Mixture spectrum and contributions thereto of each component; and (2) Partial mass spectra—arbitrary divisions per micron partial pressure. From the data and the patterns of pure unmixed molecules, the percentage of each kind of molecule present in a sample can be computed by simple algebra. Three illustrations of the Model 21-102, Consolidated Mass Spectrometer are given. W. H. C

Engine Fuels.

1901. Cold-Starting Abilities of Various Substitute Motor Fuels. R. E. Streets. *Bur. Stand. J. Res. Wash.*, July 1947, **39** (1), 39–47.—Tests have been carried out on minimum starting temperatures and warming-up characteristics of the following non-hydrocarbon fuels: 200-proof ethyl alcohol, commercial grade; 190-proof ethyl alcohol commercial grade; diethyl ether; *iso*octane; acetone; and other reference fuels.

The test engine was a reconditioned 1939 Ford V8, and the method used was "C.F.R. Procedure for Testing the Starting and Warming-up Characteristics of Fuels," C.R.C. designation F-6-1943. The complete unit was placed in a refrigerated altitude chamber.

Results show that operation on ethyl alcohol is possible over a wide temperature range if small percentages of more volatile compounds are added. The most effective additive was diethyl ether. Warming-up with ethyl alcohol and its blends is much slower, and does not produce temperatures high enough for good distribution and vaporization.

Tests under altitude conditions are evaluated.

The text is illustrated by a number of graphs, and a table shows the blends necessary to provide adequate starting at various temperatures at sea-level. A list of six references is appended. W. M. H.

1902. Quality Trends in Motor Fuels—Central United States, 1929–1946. H. M. Trimble, L. A. McReynolds, and W. H. Dunaway. *Oil Gas J.*, 4.10.47, **46** (22), 61.—A comprehensive survey of volatility trends of central United States motor fuels has been previously reported for the years 1929 to 1934. The present paper extends that report to 1946. The volatility increased rapidly from 1931 to 1942, but decreased during the the next three war years, pre-war standards again being reached in 1946.

Housebrand and premium gasolines showed seasonal control at the 50 and 90% evaporated temperatures throughout most of the period covered, although there was some loss of control at the 90% point during the war years. Antiknock values increased, volatility increased, and vice-versa.

Volatility spread between the most volatile 20% and the least volatile 20% of housebrand gasolines is greater than that between average premium and average third-rate gasolines. Premium gasolines continued to lead the three grades in overall volatility, but the lead decreased beginning with the war years.

Winter gasolines marketed in the central United States showed a higher volatility than those marketed in the country as a whole, particularly at the 10 and 50% evaporated points. Such regional variation was not evident for the summer gasolines.

Seven figures illustrate the various trends. G. A. C.

1903. Fuels and Lubricants for Aero Gas Turbines. C. G. Williams. *J. Inst. Petrol.*, 1947, **33**, 267–306. (*Inst. Petrol. & Roy. aero. Soc., London*, Feb. 1947.)—Maintenance of fuel flow in aero gas turbines may be impeded by freezing of, or corrosion by water in the fuel, or by high viscosity or freezing of the fuel at low temperatures. It is suggested that the water solubility of fuels of a given molecular type will increase with decreasing mol. wt. and that generally it will increase with aromatic content of the fuel. Details of an apparatus built to study the question of filter clogging by this water are given. Clogging by ice was entirely eliminated by adding 0·5–1% of *iso*-propyl alcohol to the fuel and it was found that the conventional cloud-point might be used to indicate the temperature at which serious interference with fuel flow is likely. Four principal methods of determining combustion efficiency are discussed. Of these an advantage of the gas analysis method lies in its application to a continuous recording apparatus, the principle being that if a gas containing CO_2 is bubbled through a dil solution of Na bicarbonate the solution acquires a definite pH which is determined by the partial pressure of the CO_2 in the gas. Thus by reading a pH meter the CO_2 content can be recorded, an accuracy of 2% is claimed for this. It is deduced that the factors controlling combustion efficiency with different fuels under most conditions depend on the physical properties of the fuels. A formula has been developed to show the relation between carbon deposition, C : H ratio and the 10% distillation temperature of the fuel, carbon deposition tending to increase with the C : H ratio and with increasing 10% temperature. Carbon deposition is a contributory cause to the buckling of flame tubes under excessive temperature gradients. Relative fire safety of fuels is discussed and flash-points and self-ignition temperatures of some are listed, together with results of empirical experiments on ignition above heated flat surfaces.

A turbine engine has to be motored at 1500 r.p.m. during starting so reduction of friction torque demands a low viscosity oil with as high a V.I. as possible.

A. R. W. B.

Lubricants.

1904. Interpretation of Electron Diffraction Patterns from Hydrocarbon Films. J. Karle and L. O. Brockway. *J. Chem. Phys.*, 1947, **15**, 213–225.—Liquid films absorbed on metals are very important in relation to lubrication and corrosion inhibition problems. Theoretical scattering functions, previously determined by making simplifying assumptions, are used to construct intensity contour maps of patterns corresponding to five different cases of molecular orientation. Experimental patterns for cerotic and stearic acids on different metals are shown and analysed for molecular orientation by means of the contour maps previously derived. D. F. J.

1905. Some New Aspects of Pour-Depressant Treated Oils. C. E. Hodges and D. T. Rogers. *Oil Gas J.*, 4.10.47, **46** (22), 89.—A number of winter field tests have been carried out at several northern localities in North America. From the results obtained, improved laboratory tests and pour point depressants have been developed. The effect of type of climate and of incorporating bright stock in motor oil blends on pour stability has been studied and also the effects of extent of dewaxing, amount of depressant, and increase of pour depressant in high cloud motor oils.

Points of practical interest to compounders of winter grade motor oils are stressed. The A.S.T.M. pour test is useful as a control test and for measuring the amount of pour

depressant to be used, but it cannot be relied upon to predict the top temperature at which an oil may solidify. Certain oils go solid in the field at temperatures above their A.S.T.M. pour point, others remain fluid well below it.

The test devised by the Standard Oil Development Co. predicts the field performance of winter grade motor oils with precision. It is stated that as a result of these stability studies, improved pour point depressants have been in use during the last two winters.

G. A. C.

Derived Chemical Products.

1906. Petroleum Chemicals Reviewed. R. F. Goldstein. *Petrol. Times*, 30.8.47, **51**, 843; 13.9.47, **51**, 892.—Some of the more recent developments in the petroleum chemicals field are reviewed. The American Hydrocol Process, which is an adaptation of the Fischer–Tropsch reaction, and the new field of fluorine petroleum chemicals are the chief topics of discussion.

R. B. S.

Coal, Shale, and Peat.

1907. Recovery of Benzol Forerunnings from Gas Works Crudes. Anon. *Industr. Chem.*, 1947, **23**, 665–672.—"Wild Gas" (5% of the total intake of crude benzol) is recovered for blending with motor spirit, being continuously absorbed in light solvent (b.p. 140–160° C). The "crude rich solvent" is agitated with ammonium polysulphide to remove CS_2, which is subsequently recovered from the aqueous solution by distillation. CS_2 recovery and reagent regeneration are simultaneously performed by collecting the distillate of CS_2 under water. An upper aqueous layer of ammonium sulphide is formed to which is added the sulphur left in the distillation residue. The process described (covered by B.P. 419,312 and 575,553) is operated by Midland Tar Distillers Ltd.

E. B.

1908. Regeneration of Spent Wash Oils Without Distillation. J. Carabasse. *Chim. et Ind.*, 1947, **58**, 228–233.—A chemical method of regenerating wash oil used in stripping benzol from coke-oven gas has been developed by the by-products division of the French Coal Board. A proportion of the oil is withdrawn from service, the benzol removed by steaming and the hot oil then strongly agitated with concentrated NaOH solution. The mixture is separated into two layers either by settling or centrifuging, the upper regenerated oil is returned to the absorption plant whilst the emulsified aqueous layer is diluted with water and separated into a viscous asphalt and a caustic solution containing appreciable amounts of phenols.

V. B.

1909. Pulverized Fuel. T. F. Huxley. *Nature*, 1947, **160** (4062), 318–320.—The advantages of pulverized coal, obtained by grinding until 80% will pass a 200 B.S. sieve, are that it can be carried and burned in suspension, and that low grade coals can be utilized. The disadvantages are concerned with the presence of incombustible matter and the removal and disposal of ash.

With modern equipment the fuel is ground and dried as required. The nature of the grinding mills depends on the type of installation, and the amount of moisture left in the coal should be within 1% of its inherent value. The combustion chambers are large so that the temperature of the ash particles is reduced below fusion point before the convection heating surfaces are reached. 70–80% of the ash is carried out of the boiler, and whilst this assists in the maintenance of the installation the ash must be removed from the flue gases. This can best be done by a centrifugal separator, involving a number of small cyclones, in series with an electrostatic precipitator.

Although coal is the fuel most used in pulverized form in Great Britain, hard pitch and brown coal can also be burned in this way. It is concluded that although ways may be found of improving the methods now employed, pulverized fuel will not compete with oil, which has all the advantages and few of the disadvantages of pulverized fuel.

H. C. E.

Miscellaneous Products.

1910. Aluminium Dilaurate as Association Colloid in Benzene. J. W. McBain and E. B. Working. *J. phys. & coll. Chem.*, 1947, **51**, 974.—The theory that aluminium dilaurate in benzene is an association colloid is based upon measurements of osmotic pressure and viscosity. The osmotic pressure measurements are made at 20° C and 50° C and use cellophane membranes. The osmotic pressure divided by concentration decreases very rapidly with concentration, whereas for polymeric colloids the same ratio increases with concentration. The viscosities, which are measured at 20° C and 40° C by means of an Ostwald viscometer, show an increase with increase of temperature whereas those of polymeric colloids are independent of temperature. D. F. J.

1911. Preparation of Butadiene from Mixtures of Alcohol and Acetaldehyde. R. Rigamonti. *Chim. e Industria*, 1947, **29** (7), 172.—The preparation of butadiene is a problem of great importance for the preparation of synthetic rubber. One process which showed promise at the time of the First World War is that of Ostromyaslenski, employing the reaction in blends of alcohol and acetaldehyde wtih alumina as catalyst. In the recent war, the process was further perfected by workers at the Carbide and Chemicals Corpn, using as catalyst tantalum and zirconium oxides on a silica base. Work is described in this paper in which alumina, with and without promoters, and a silica–magnesia mixture are used as catalysts. D. H. McL.

1912. Bouveault Reduction of Some Natural Glycerides. G. Jacini and P. Chiesa. *Chim. e Industria*, 1947, **29** (7), 172.—The reduction with sodium and butyl alcohol of olive, linseed, and castor oils is described. The corresponding alcohols obtained all show an iodine number equal to that of the original glycerides. D. H. McL.

1913. Heavy Metal Soaps of Wool-Wax Acids. E. S. Lower. *Industr. Chem.*, 1947, **23**, 645–651.—Paint driers have been produced in Germany by reacting wool-wax acids with salts of Co, Mn, Pb, or Zn. Naphthenic or fatty acids can be used jointly with the wool-wax acids. Heavy metal salts of wool-wax acids can be used as hydrogenation catalysts, whilst mixtures of such soaps with waxy materials are suitable for grease manufacture. A tough plastic material (for roofing felts) is made by heating the Al soap with bitumen. Zinc soaps of the acids can be used as pour depressants; the Ca soaps are suitable for hot neck and "Stauffer" greases. The interaction of wool-wax acids with P_2S_5 at 150–400° F, followed by saponification of the phosphorized product with a suitable base (*e.g.*, $Ba(OH)_2$), yields materials claimed to have E.P. properties. Such substances are also reported to have oxidation-inhibiting, corrosion-reducing, and anti-ring-sticking properties as well as being oiliness improvers and pour depressants. Tabulated results are given showing the effect of the metal soaps of the phosphorized wool-wax products on bearing corrosion (Underwood test), Lawson varnish test, ring-sticking, and pour point. E. B.

Engines and Automotive Equipment.

1914. Calculated Performance of Dynamically Loaded Sleeve Bearings. J. T. Burwell. *J. app. Mech.*, 1947, **14**, A231–A245.—From the equations of Harrison and Swift, a theory is developed analysing any dynamically loaded bearing whose polar load diagram is known. The method is applied to the bearings of a diesel-engine connecting-rod and a radial-aircraft-engine master-rod, and it is shown that the results can be generalized and applied to bearings under all other operating conditions. D. F. J.

1915. Filter Aspect of Engine Wear. Anon. *Gas Oil Pwr*, 1947, **42** (504), 265.—In testing a well-known make of filter, an 8-h.p. 4-cylinder petrol engine was run in the laboratory for an equivalent of 2500 miles in an atmosphere containing 0·5–1·0 g dust per 1000 cu. ft. of air. The following table gives the wear, in thousandths of an inch, of the cylinder assembly:

	No filter.	Air filter.	Air and oil filter.
Piston wear	2·5–5	1	1
Cylinder wear	9–13	4	0·33

Measurements on piston ring, valve stem, valve guides, main bearing, big-end bearing, and crankshaft showed that the wear was reduced by an average of 65% when an air filter was used, and by a further 20% when both air and oil filters were employed.

The air filter caused a pressure drop which eventually became constant at about 2·4 in of water.

Fuel and oil consumption were appreciably reduced by the use of filters. With an air filter alone the oil consumption was reduced by 53%; with air and oil filters this figure was 75%. Collaterally, the deposits from piston crown and combustion chamber were reduced by 27% with air filter, and 48% with air and oil filters. Analysis of the lubricating oil after use also showed general improvements when filters were employed, although the acidity of the oil was increased. H. C. E.

1916. Introduction to an Analysis of Gas Vibrations in Engine Manifolds. R. C. Binder and A. S. Hall, Jr. *J. app. Mech.*, 1947, **14**, A183–A187.—The performance of an I.C. engine may be influenced by the vibration of gas in the manifold. An introduction is provided to the analytical techniques of calculating the vibrational characteristics. The theory is outlined and then applied to the problem of a simple engine induction system. Possible ways of extending the system into more complicated fields are given. D. F. J.

1917. C.A.V.-Ricardo Pintaux Nozzle. Anon. *Gas Oil Pwr*, 1947, **42** (504), 279–281.—This nozzle has been designed to ensure easy starting from cold with the well-known Ricardo Comet type of cylinder-head. In previous patterns of the latter, a heater plug was fitted to the spherical chamber to heat the compressed air sufficiently to ignite the fuel spray readily.

With the normal type of pintle nozzle the hottest zone of the chamber under starting conditions is outside the spray path, which is so placed that the optimum degree of air-swirl is created. The Pintaux nozzle directs the bulk of the fuel spray through an auxiliary ignition hole to the hot zone, but when ignition occurs and the engine speed rises the fuel is directed through the pintle hole in the normal manner for optimum engine performance. To achieve this effect the auxiliary hole is in communication with an annular space between the seating and the main nozzle; when starting the needle is not lifted sufficiently to clear the pintle hole and the fuel is therefore discharged through the auxiliary hole. At higher pump speeds the needle is withdrawn completely and normal injection occurs.

High-speed photographs of the starting and running sprays of the Pintaux nozzle are given. H. C. E.

1918. Harland and Wolff 4-Stroke Engines. Anon. *Gas Oil Pwr*, 1947, **42** (504), 273.—Specifications and construction of the three basic types of 4-stroke engines are described. A feature of these engines is that they may be run on town or sludge gas when required; in one case the change from oil to gas can be made with the engine on load. H. C. E.

1919. High-Power Ruston 4-Stroke Engine. Anon. *Gas Oil Pwr*, 1947, **42** (504), 282–284.—These 4-stroke vertical engines have from five to nine cylinders, with a standard pressure-charged output of 268 b.h.p. per cylinder. Cylinders have 17-in bore and 18-in stroke; the top speed is 435 r.p.m., b.m.p. is 119 p.s.i., and specific fuel consumption at full load 0·37 lb/b.h.p.hr.

General construction of the engine is described, the cylinders, crankshaft, pistons, and valve gear being treated separately. Each cylinder is provided with a fuel pump, and the quantity of fuel injected is varied by a governor control on a by-pass system. Fuel injectors are of the spring-loaded multi-hole type with a self-centring nozzle. Duplex fuel filters are fitted on the suction side of the fuel pumps. The exhaust manifolds are connected to an exhaust turbo-driven pressure charger consisting of a single-stage centrifugal blower driven by the exhaust gas turbine.

Forced feed lubrication is provided for all the main working parts of the engine except the valve gear, which has wick-feed lubricators, and the cylinder liners. Lubrication is on the dry-sump principle with independent pumps and tank in which cooling coils are fitted. H. C. E.

1920. First Marine Gas Turbine in Service. Anon. *Motor Ship*, Oct. 1947, **28**, 256.—Information is obtained for the first time of the installation of a 2500 b.h.p. Metropolitan–Vickers gas turbine in an Admiralty motor ship. Installation details are given, together with technical information on their performance. The gas generator unit produces gas at 1250° F for consumption in the power turbine, which is geared to the propeller shaft coupling. The engine is situated centrally and supplements the power of the wing engines which are Packard petrol engines, each capable of an output of 1250 b.h.p.

The fuel used on trials was Pool gasoil and this is converted into heat in the annular upstream injection Metropolitan–Vickers design combustion chamber. I. G. B.

1921. Some Economics of Gas Turbine Locomotives. Anon. *Ingenieur*, 29.9.47, **59** (39), V25–26.—Gas turbine locomotives were put into operation on to one of the Swiss lines and have run for 50,000 Km without overhaul, the combustion chambers having had 1614 hr continuous service. It has been found that the ratio of lubricating oil cost to fuel cost for a diesel motor is 10–30%, the ratio of the two costs for a gas turbine being so small as to be negligible. With the price of fuel twice the cost of lubricating oil for a diesel engine, then the energy cost of a gas turbine having a thermal efficiency of 19% is equal to that of a diesel engine having a thermal efficiency of 38%. N. C.

1922. Jet-Engine Efficiency Test Devised by Shell. Anon. *Oil Gas J.*, 20.9.47, **46** (20), 322.—Some brief notes are given of several important advances relating to jet-engine performance made by the Wood River, Ill., U.S.A. research staff of the Shell Oil Co. An improved method of determining the efficiency of jet-engine performance is due to a new technique of analysing exhaust gases, and means for running continuous tests have also been devised. The major causes of carbon deposition in jet-engines have been discovered. The chief factors are: (1) fuel composition, (2) fuel volatility, (3) intake temperature, (4) method of introducing the fuel, and (5) conformation of the combustion chamber. The investigations have shown that carbon deposition can be reduced by altering these factors. A new type jet burner has ben devised that produces 250 times as much heat as a residential-type oil burner. It creates a stream of hot gases at extremely high velocity. A 1000-h.p. compressor supplies the air for combustion. W. H. C.

MISCELLANEOUS.

1923. Controlled Furnace-Atmospheres. Anon. *Aircr. Prod.*, Oct. 1947, **9** (108), 380.—Messrs Wild–Barfield have introduced a kerosine burner for use in controlled furnace atmospheres. The kerosine is fed at a predetermined pressure via a pump to the vaporizers. Resulting atmosphere is suitable for a range of steels from low to high carbon types, maintaining its effectiveness over a furnace temperature range of from 700° C to 1400° C. Examples of test reports are given in a table. I. G. B.

1924. Natural Gas for the North-Eastern Seaboard. L. F. Ferry. *Min. & Metall.*, July 1947, **28**, 326.—This article reviews the expansion of the marketed production of natural gas, and the extension of pipelines as markets increased. New pipeline projects to meet the increasing demand are mentioned. The basic reasons for the increasing demand are: (1) Increasing known reserves. (2) Larger diameter pipelines reduce transportation costs. (3) Better pipes and better compressors permit higher pressures. (4) Recognition of the dependability of gas reserves. (5) Reduction in transportation costs has opened new markets and increased the demand in existing markets. Transportation costs of natural gas are compared with those of coal:

Gas 1·25–1·35 cents/million B.Th.U/100 miles.
Coal (by rail) 2·35 cents/million B.Th.U./100 miles.

Proved reserves of natural gas on December 31, 1946, are estimated at 160 trillion cu. ft., 28% larger than crude oil reserves in terms of B.Th.U. content. The source of supply for the northeastern seaboard will be the Texas and Louisiana Gulf Coast. An alternative market for the gas is the Appalachian area. C. G. W.

1925. German Oil Seal Moulding : Technical Evaluation. J. Forrest. *India-Rubber J.*, 1947, **113** 155–158.—The design and raw materials used in the manufacture of German oil seals are described in comparison with those of the Allies during the recent war. The preparation of blanks, and questions of conomics and quality of production are dealt with, some technical details of production being given. Inspection standards and testing methods are compared. C. N. T.

1926. Kuwait Comes into Production. Anon. *Pipe Line News*, June 1947, **19** (6), 9.—This article outlines the geography, climate, industries, and living conditions of Kuwait. The development of the oil industry from 1934 up to the suspension of activities in 1942 and future plans for development are very briefly indicated. C. G. W.

1927. United Kingdom Petroleum Trade in 1947 : Details for June and the Six Months. Anon. *Petrol. Times*, 2.8.47, **51**, 754.—Details are given of U.K. imports and exports of crude oil and refined products for June and the first 6 months of 1947. Comparatives figures of 1946 are also given. R. B. S.

1928. United Kingdom Petroleum Trade in 1947. Details for July and the Seven Months Anon. *Petrol. Times*, 30.8.47, **51**, 845.—Tables are presented of U.K. imports and exports of crude oil and refined products during July and the first 7 months of 1947 together with comparative figures for the corresponding periods of 1946. R. B. S.

1929. United States Petroleum Industry in the First Quarter of 1947. Anon. *Petrol. Times*, 19.7.47, **51**, 702.—Details are given of U.S. crude production by States and principal fields. A table is also given showing production, imports, exports, stocks, and demand of refined products. R. B. S.

BOOK REVIEW.

American Petroleum Refining. H. S. Bell. New York : D. Van Nostrand ; London : Constable & Co. ; 1945. 3rd Edn. Pp. 619 + xii. 32*s.* 6*d.*

The third edition of Bell has been largely rewritten and gives an account of a number of the newer refining processes which have come into use in the last few years which are otherwise unavailable except in the petroleum journal literature.

The first two chapters, Historical Development and Crude Oil and their Characteristics, have been considerably improved, but the chapters dealing with chemical and physical properties are apparently unaltered, and data of the hydrocarbons in the various series, paraffins, olefins, etc, are still taken from old German publications instead of from the more recent information available in the literature.

However, a new Chapter, V, on Physical and Engineering Data, provides satisfactory data for the hydrocarbons (not in agreement with those in the two preceding chapters), and data necessary for refinery engineering. The subjects of distillation, fractionating, and heat transfer are considered in fairly adequate detail (the McCabe–Thiele diagram is not included). An improvement is made in the section on condensers which, formerly containing a number of tables of relatively little value, has been entirely rewritten in the new edition. Many illustrations of condensers of various types are included.

A chapter on Cracking—Theory and Development, gives an interesting history of the cracking process, and it is in the next section dealing with Cracking that most alterations have been made. There is now a chapter on Thermal Cracking and another dealing with Catalytic Cracking which covers the Houdry process, the Thermofor Cracking process, and the Fluid Catalytic process, although the plant illustrated is the older form of this latter process. A chapter has been inserted in the new edition dealing with Motor Fuels and Their Requirements, although there

is no corresponding chapter on other primary petroleum products. The chapters dealing with Chemical Treatment and De-waxing Operations have been largely rewritten. The subjects discussed include Refrigeration, Solvent Extraction, and Clay Treatment and are well illustrated with photographs and line diagrams.

There are also sections dealing with storage, pumping, transportation, blending, packaging, and fire protection.

The literature references again show that the revision has not always been sufficiently drastic, as a large proportion date back to 1920 and there are few beyond 1941.

As already mentioned, this edition represents a very marked improvement over the earlier editions which are out of date. One could have wished, however, that the pruning knife had eliminated even more of some of the older material, although it is perhaps unfortunate that, for example, the question of water supply to refineries, described in earlier editions, has been overlooked in this third edition.

F. H. G.

BOOKS RECEIVED.

A New Notation and Enumeration System for Organic Compounds. G. Malcolm Dyson. London: Longmans, Green and Co., 1947. Pp. 53 + iv. 7*s*. 6*d*.

The author suggests that his new notation may go far towards solving those difficulties of chemical nomenclature that became more apparent as chemistry advances, particularly in classification and indexing.

American Oil Operations Abroad. L. M. Fanning. New York and London: McGraw-Hill Book Co. Inc., 1947. Pp. 270 + vii. $5.00.

The purpose of this volume is to survey the search for oil and the development of markets by Americans in foreign countries.

An Introduction to the Chemistry of the Silicones. Eugene G. Rochow. New York: John Wiley and Sons Inc. London: Chapman and Hall Ltd., 1946. Pp. 137 + x. 16*s*. 6*d*.

The first few chapters review the silanes and their derivatives in order to provide an understanding of the chemistry of the nonsilicate compounds of silicon. The later chapters emphasize the silicone polymers of commercial importance and deal with their preparation, properties, and uses.

Adsorption. C. L. Mantell. New York and London: McGraw-Hill Book Co. Inc., 1945. Pp. 386 + viii.

A correlation of the practical, commercial, and engineering aspects of adsorption.

Practical Emulsions. H. Bennett. New York: Chemical Publishing Co. Inc., 1947. Pp. 568 + xvi. $8.50.

Part I gives general information on emulsions and emulsification; Part II presents papers on emulsifying agents and emulsions; Part III gives formulas for emulsions for various uses.

ABSTRACTS AUTHOR INDEX.

Numbers refer to Abstract numbers.

Abadie, H. G., 1396
Abbey, A., 1689
Abernathy, J. H., 1593
Adams, C. E., 1202
Adams, E., 830, 1054
Adams, M. M., 512
Adelson, D. E., 417
Adkins, H., 629
Aiken, C. B., 1013
Airs, R. S., 876
Akins, D. W., Jr., 810
Albear de, J. F., 516
Albright, R. E., 1131
Alcock, E. D., 192, 984
Alden, R. C., 876
Alden, R. G., 879
Alexander, C. W., 79
Alexander, M., 124, 1082
Alexander, P. 876
Alexander, P. P., 121
Allen, R. C., 289
Allison, A. P., 26, 1754
Alty, H. J., 1202
Ambrose, H. A., 1047
Amero, R. C., 1192
Ames, T. S., 296
Amon, F. H., 121
Amott, E., 1289
Amyx, J. W., 820
Anderegg, F. O., 668
Anderson, B. T., 1689
Anderson, F. M., 1399
Anderson, H. H., 256, 855
Anderson, J., 121, 876
Anderson, J. A., Jr., 876
Anderson, J. F., 209
Anderson, W. W., 707
Andrade, E. N. De C., 664
Andresen, K. H., 1277
Andrus, D. T., 553
Andrus, D. W., 417
Anes, M. R., 1309, 1316
Anthony, B. L. P., 1202
Anzus, L. I., 1067
Apjohn, T. L., 1131
Appell, F., 874, 1229
Arand, A. G., 762
Arbuthnot, C. E., 121
Archer, F. G., 57
Archie, G. E., 696
Arend, A. G., 42
Ariano, R., 1217
Armistead, G., 111, 112, 1066
Armistead, G., Jr., 1186
Armstrong, E. N., 425
Armstrong, E. R., 788
Arnold, C., 876, 1072, 1202, 1689
Arnold, G. B., 121, 417
Arnold, J. C., 417, 876, 1072, 1202, 1289, 1689
Arveson, M. H., 121, 876
Asbury, W. C., 417
Aschner, E., 715, 1781
Aston, E. F., 1013
Aston, J. A., 1316
Aston, J. G., 424, 1309
Asty, J., 1240
Athey, N. D., 291
Atkins, G. T., Jr., 876
Attaway, D., 385
Atwell, H. V., 417, 876
Aubert, M., 1107
Auld, S. J. M., 460
Axe, W. N., 417, 727, 1289
Ayers, G. W., 876
Bacon, T. S., 1609
Badertscher, D. E., 876
Bagg, D. G., 904
Bahlke, W. H., 876
Bailey, C. H., 168
Bailey, G. C., 876
Bailey, T. C., 661
Bailey, W. A., Jr., 876
Baillie, J. C., 417, 876
Baker, J. S., 1423
Baker, R. H., 1296
Balandin, A. A., 1190, 1191
Ballande, H. M., 1531, 1844
Balsey, J. R., 697
Baral, W. J., 1289
Barber, C. R., 1895
Bare, P. O., 732
Barnes, K. B., 366, 1571, 1660, 1661, 1664, 1670, 1671
Barnes, W. E., 531
Barnett, B., 1867, 1868
Barr, V. L., 57
Barral, J., 1194
Barrington, R., 914
Barron, J. M., 876
Barry, A. J., 472
Barthauer, G. L., 630
Barthelmes, A. J., 983
Bartleson, J. D., 417, 620, 656
Barton, D. M., 876
Barton, J. M., 1134
Bass, N. W., 1140
Bastiansen, O., 1493
Batchelder, A. H., 417
Batchelder, C. D., 1858
Bates, F. W., 70
Bates, J. R., 1689
Bates, R. L., 72, 1747
Bates, T. F., 534
Battershill, F. J., 661
Bauer, E. S., 355
Bauer, G. G., 816, 831, 921, 923, 1126
Bax, A. R., 876
Baxter, A. D., 1716
Bazzoni, C. B., 706
Beach, F. K., 691, 805, 806, 1050
Beach, J. Y., 1328
Beacham, C. C., 967
Beacon, G. B., 121
Beals, T. H., 1055
Beatty, H. A., 651
Beck, J. V., 222
Beckelhymer, R. L., 27
Beebe, R. A., 1290
Beerbower, A., 1289
Beilharz, C. F., 85
Belchetz, A., 876
Bell, A. H., 68, 1737
Bell, E. A., 1850
Bell, J. S., 178
Bell, M. F., 1329
Bell, R. T., 876
Beloussov, V. V., 952
Bench, B. M., 686
Bender, P., 1897
Bender, R. O., 417
Benedectis, A. De, 876
Bennett, D. A., 706
Bennett, G. A., 858
Benson, S. W., 1891
Bentley, F. J. L., 876
Bentz, E. J. H., 308
Benz, G. F., 1231
Berg, C. H. O., 876
Berg, L., 597, 598
Berger, H. G., 876, 1202
Bergh, S. V., 478
Berliney, M., 417
Bernstein, H. J., 1877
Berret, R., 1486
Berti, V., 1506
Best, D. M., 1251
Bestougeff, M., 1086
Beuther, H., 273, 587, 588
Bevarly, H. W., 144
Bevis, W. A., 914
Beyon, H. J., 1072
Bielkowicz, P., 882
Bigelow, W. C., 899
Billington, L., 336
Binder, R. C., 1916
Birch, S. F., 876, 1883
Biscoe, J. 1290
Bishop, R. B., 876
Blackburn, B. O., 417
Blackburn, C. E., 60
Blackburn, M. A., 1797
Blair, C. M., Jr., 581
Blaker, R. H., 1335
Bland, R. E., 405, 1187
Blanding, F. H., 906
Blau, C. M., Jr., 1289
Bleloch, W., 1507
Bloch, H. S., 876, 1689
Bloomquist, W. C., 548, 549, 815
Blott, J. F. T., 876
Bludworth, J. E., 907
Blum, V. J., 186
Bobo, R. A., 1264
Bogart, L. G. V., 1289
Boggess, H. W., 728
Bohmer, C. W., Jr., 876
Boice, J. E., 1501
Boisblanc, D. R. de, 288, 646
Boisselet, L., 468
Bolinger, J. C., 1289
Bolt, J. A., 876, 1705
Bond, D. C., 1289
Bond, G. R., Jr., 645, 1072
Bondi, A., 458, 459, 663, 1693, 1699
Bonnell, W. S., 600
Boots, P. H., 968
Borden, J. L., 76
Bornhauser, M., 944
Boss, R. L., 1755
Bossler, R. B., 223
Bottomley, H., 388
Boucher, H. G., 876
Bouchet, R. L., 451
Bowden, G. A., 417
Bowden, R. H., 114
Bowden, S. T., 1206
Bower, T. H., 682
Bowers, E. F., 1615
Boyd, L. H., 964
Boyer, R. L., 1414
Braddicks, R., Jr., 1095
Bradley, W. E., 876
Brancker, A. V., 129, 439, 738, 885, 1079
Brancker, V. 476
Brandon, C. W., 718
Brandon, G. M., 718
Brandt, P. L., 398
Brattain, R. R., 1694, 1695
Breese, J. L., 1689
Breger, I. A., 626
Bressey, R. J., 661

Brewer, A. G., 1013
Brian, T. P., 1289
Brickwedde, F. G., 424
Bridgwater, R. M., 165
Brink, K. C. Ven, 876
Brinkley, S. R., Jr., 1295
Brise, V. H., 1502
Brock, W. H. J., 66
Brockway, L. O., 1312, 1904
Brod, I. O., 169, 171
Brook, K., 914
Brooks, F., 634
Brooks, J. W., 876, 1072
Brooner, G. M., 275
Brown, A. F., 1876
Brown, C. J., 1289
Brown, C. W., 649
Brown, G. S., 416
Brown, H. S., 706
Brown, L. C., 1189, 1479, 1482
Brown, R. W., 21
Brown, W., 701
Bruce, W. A., 1616
Bruckshaw, J. M., 1585, 1586
Brumbaugh, A. K., 720
Bruner, F. H., 1689
Buchan, R. C., 346, 1816
Buchdahl, R., 1095
Bucher, J. E., 86
Buckley, S. E., 53, 220
Buddrus, E., 1047
Bullard, E. F., 876
Burch, J. G., 1812
Burdett, R. A., 1318, 1319
Burgess, J. E., 876
Burgess, S. G., 1893
Burgin, J., 876
Burgoyne, J. H., 1200
Burk, R. E., 121, 417, 620, 727, 876, 1072, 1289
Burns, W. W., 566, 567, 782, 833, 1283, 1376, 1383, 1439, 1449, 1465, 1470, 1623
Burroughs, L. C., 579
Burrows, L. A., 1289
Burton, V. L., 626
Burwell, J. T., 1914
Busey, R. H., 630
Butcher, E. R., 121
Butyagin, P. J., 1077
Byers, A., 1886

Cabeen, W. R., 505
Cade, G. N., 613
Cadman, W. H., 148
Caesar, C. H., 1866
Cagniant, P., 1068, 1102
Cahill, J. C., 1074
Caldwell, J., 1047
Calhorne, J. C., Jr., 1030
Calhoun, J. C., 1819
Calhoun, J. C., Jr., 1425
Camp, E. Q., 876
Campbell, D. L., 1072, 1289
Campbell, J. H., 1019
Campbell, J. M., 876
Campbell, O. E., 200
Canal, P., 1495
Cannon, G. E., 1013, 1391
Cannon, M. R., 608, 672
Cantrell, C. D., Jr., 876
Cantrell, R., 1138
Cantrell, T. L., 121, 718, 876, 1289
Capitani, C., 445
Capshaw, E., 1263
Carabasse, J., 1908
Cardwell, P. H., 1418
Carlile, J. H. G., 419
Carlson, G. J., 1289
Carlson, H. A., 57
Carmody, D. R., 876
Carney, S. C., 876, 1047
Carpenter, G. B., 1696
Carpenter, M. T., 876
Carr, D. E., 121
Carre, I., 1230
Carter, A. S., 732
Carter, H. D., 1514
Carter, J. C., 417
Carver, E. K., 1334
Case, L. C., 58, 59
Cash, T. C., 1750
Cashman, A. F., 727, 876
Cass, O. W., 876
Cattaneo, A. G., 876
Cauley, S. P., 1499
Cavanagh, R. S., 1250
Cavaness, J. D., 707
Cave, W. T., 1207
Cawley, C. M., 419
Cejka, S. A., 1047
Cerveny, W. J., 1326
Chambre, P., 151
Chaney, P. E., 1607
Charron, F., 1212
Chase, C. L., 86
Chatelus, G., 1068
Chechot, V. I., 417
Cheney, H. A., 412, 876
Cheney, M. G., 12
Chenicek, J. A., 876, 1289
Chia-Chiao Lin, 151
Chibaeff, V., 1184
Chien, Jen-Yuan, 1897
Chiesa, P., 1912
Childers, R. O., 706
Chovin, P. 276
Chronic, C. J., 1766
Clark, C. R., 876
Clark, J. B., 706
Clark, J. M., 1023
Clark, N. O., 1201
Clarke, A. E., 125, 431
Clarke, J. S., 1223
Clarke, L. A., 417, 876, 1689
Clason, C. E., 797
Claussen, W. H., 727
Clay, J. A., 703
Clay, J. A., Jr., 1475
Claypool, C. B., 1754
Claypool, R. M., 1251
Cleveland, F. J., 1689
Clifford, I. L., 1072
Clinedinst, W. O., 214, 446
Coburn, A. E., 1496
Codet, H. G., 876
Coffin, R. C., 328, 1792
Coggeshall, N. D., 287
Coghlan, C. A., 1202
Cohee, G. V., 685, 1548
Cohen, C. A., 1689
Cole, R. M., 876, 1689
Cole, T. C., 622
Cole, V. B., 74, 1736
Coles, K. F., 1885
Coley, J. R., 1298
Collins, C. P., 795
Collins, D. B., 1047
Collins, F. C., 653
Collins, M. M., 727
Collis, C. B., 876
Colomb, M., 1102
Conant, L. C., 13
Conn, M. W., 275
Connolly, G. C., 876
Connors, J. S., 727
Conrad, A. L., 656
Conroy, E. A., 672
Cook, M. G., 1097
Cook, W. H., 1597
Cooke, S. R. B., 182
Corbin, N., 124, 1082
Corcijera, C., 463
Corson, B. B., 621, 1326
Cortes, H. C., 11
Cosby, J. N., 1297
Costin, W. B., 1013
Cotey, B. J., 1408
Coultrup, J. G., 1428
Courter, L. A., 1013
Cowles, L. G., 202, 706
Cox, B. B., 7
Cox, C. E., 313
Cozzens, F. R., 1257, 1269, 1437
Craft, W. S., 1289
Crake, W. S., 63
Crane, F. S., 1013
Crawford, B. L., Jr., 1898
Crawford, C. C., 293, 727
Creelman, G. D., 876
Critz, J. S., 709, 1137, 1758
Critz, P. F., 669
Cross, R. J., 717
Crouch, J. O., 1281
Crowell, A. M., 1447
Crowley, J. A., Jr., 1202, 1289
Crowther, J. F., 876
Crutchfield, J. W., 379
Cubberley, R. H., 876
Cullen, R. J., 1739
Culmer, T. W., 1289
Cummings, G. H., 876
Cupples, H. L., 417
Curado, J. G., 1095
Curtiss, L. F., 706

Dale, O. O., 1268
Dana, F. E., 1047
Danforth, J. D., 1202, 1289
Daniels, L. G., 66
Daniels, L. S., 401
Danner, A. V., 876
D'Arcy, N. A., 242, 796
Daric, G., 853
Darley, H. C. H., 1160
Darmois, R., 1086
David, H., 568, 569, 1151, 1348, 1801, 1826
David, L. R., 1238
Davies, E. B., 662
Davies, J. A., 266
Daviess, S. N., 14
Davis, D. M., 85
Davis, L. F., 812
Davis, O. L., 1202
Davis, W. J., 1058
Dawson, H. M., 970
Day, A. H., 251
Day, R. B., 876
Day, R. J., 544, 808
Dean, P. C., 1279
Deckert, H. B., 1013
Deegan, C. J., 240, 570, 1049, 1135, 1239, 1349, 1355, 1382, 1443, 1543, 1556, 1612, 1642, 1648, 1900
Deely, C, 1391
Deering, R. F., 876
Deflour, J. G., 1863
DeGolyer, E., 746
DeHettre, J. P., 215
Delgass, E. B., 1499
Delion, R. 721
Deluzarche, A., 1068, 1102
Delwaulle, —, 438
Demmerle, R. L., 725
Dent, F. J., 876
Derjaguin, B., 1108
Derrig, M. J., 627
Devaney, L. W., 727
Diamnod, H., 876
Dietrich, M. A., 1289
Dickinson, J. T., 876
Dickinson, N. L., 876
Dight, S. R., 930
Disney, R. W., 767
Dix, C. H., 196, 993
Dobbin, C. E., 946, 1730
Dodd, C., 664
Dodd, J. D., 176
Doll, H. G., 1808
Donn, L., 636
Donohue, D. A., 596
Dons, E. M., 1202
Doshier, A. W., 1752
Dougherty, P. F., 706
Doumane, T. F., 878
Doumani, T. F., 876, 1289
Douslin, D. R., 610
d'Ouville, E. L., 417, 876

Dow, R. B., 1110
Drennan, H. E., 878
Dresbach, C. H., 208, 971
Dreyfees, H., 1689
Duff, D. M., 659
Dugan, A. F., 207
Dunaway, W. H., 1902
Duncan, G. W., 417, 876
Dunigan, J. D., 1009
Dunlap, W. E., 506
Dunlop, J. B., 121
Dunn, J. H., 1132
Dunn, J. J., 337
Dunn, R. E., 613
Durinski, A. M., 417
Durrum, E. L., 876
Dwyer, T. H., 1165
Dyson, G. M., 1884

Eardley, A. J., 37
Eargle, D. H., 13
Eastman, B., 727
Eby, J. B., 1779
Eccleston, B. H., 605
Eckel, J. E., 798
Edmister, W. C., 1411
Edmunds, F. H., 1764
Edwards, R. E., 1011, 1047
Egloff, G., 124, 417, 893, 1082, 1125, 1241
Eichner, C., 592
Eilerts, C. K., 57, 543, 1162, 1163
Elias, M. K., 23
Elkins, L. F., 369
Ellenberger, F. W., 1277
Elliott, J. S., 1202
Ellis, S. R. M., 1689
Ellison, S. P., Jr., 3
Elovich, S. J., 1077
Endean, H. J., 1164
Engelke, E. F., 1202
Engelking, E. H., 417
Esarey, A. E., 1737
Ess, P. R. Van, 727, 1202
Estorff, F. E. Von, 31
Evans, A. G., 877
Evans, E. A., 417, 1202
Evans, H. C., 1202
Evans, L. P., 1289
Evans, T. W., 727, 876, 878, 1289
Everett, E. F., 410
Evering, B. L., 121, 417, 876
Ewing, F. J., 1202
Exline, P. G., 1164
Eyring, H., 1111

Fagin, K. M., 331, 342, 349, 354, 699, 787, 791, 822, 998, 1400
Fairbridge, R. W., 2
Fairweather, H. G. C., 876, 1202
Falkins, H. O., 1289
Farkas, A., 1202
Farley, F. E., 147
Farmer, E. H., 733
Farmer, H. O., 314
Farris, R. F., 706
Fawcett, E. W. M., 121, 876, 1072
Fawcett, F. C., 609
Fawcett, F. S., 618
Fay, P. S., 656
Feacham, C. G. P., 1072
Featherly, R. L., 1472
Feiser, L. F., 1306
Fenske, M. R., 876
Ferretti, P., 305
Ferris, S. W., 876
Ferry, L. F., 1924
Fidler, F. A., 876
Field, E., 640, 647, 648
Field, H. W., 274
Field, J. H., 1258
Fielder, J., 479
Fieser, L. F., 670
Fife, J. G., 876, 1072
Fillippone, W. R., 973
Fink, F. W., 541
Fink, H. L., 1309, 1316
Finley, W. L., 121
Fischer, H. G. M., 1289
Fisher, S. T., 718
Fiske, F. K., 1380
Flanagan, H. J., 1074
Flanders, J. E., 384
Flaxman, M. T., 1689
Flett, L. H., 417
Flett, M. St. C., 1207
Flock, B. J., 108
Flood, E. L., 876, 1261
Flon, J. G. De, 1177
Flor, J. G. De, 1061
Fogel, M. C., 273, 587, 588
Fohs, F. J., 1575, 1780
Folkins, H. O., 121, 417
Forbes, R. T., 1185
Forman, H., 1471
Forney, W. E., 876
Forrest, J., 1925
Forunier, F. L., 1760
Foster, A. L., 107, 113, 267, 876, 1286, 1337, 1686
Foster, F. K., 1551
Foster, G. L., 1505
Foster, H. L., 1729
Foster, J. L., 707
Foster, S. W. G., 150
Foster, T. R., 719
Fowler, F. C., 1018
Fox, R. E., 1701
Francis, A. W., 601, 1301
Francois, F. 438
Frang, R. A., 121
Fratis, J. E., 876
Fred, M., 637
French, F. A., 277
Freund, M., 130, 440, 441, 457
Frey, F. E., 417, 727, 876, 1289, 1309
Friedman, B. S., 417
Frishman, L. E., 704
Friske, W. C., 453
Frosch, A., 1013
Frowe, E. W., 980
Frye, J. C., 23
Fu, C. Y., 986, 987, 988
Fugitt, Le R., 82
Fuller, E. W., 1202
Fulton, D., 1478
Furth, M. A., 706

Gabriel, V. G., 975
Gaby, P. P., 195
Gallia, R., 1202
Galstaun, L. S., 876
Galt, J. K., 1704
Gambrill, C. M., 644
Gandolfi, R., 321
Garner, F. H., 125, 431, 890, 1080, 1892
Garrison, A. D., 876
Gartin, E. G., 1013
Gassett, P. L., 707
Gebauer, A. H., 876
Geckler, R. D., 411
Geist, J. M., 608
Gemant, A., 279
Gerard, P., 1503
Gerhold, C. G., 876
Giammaria, J. J., 417, 1202
Gibbon, A., 362, 373, 1592, 1740
Gibbons, L. C., 611, 612
Giblin, P., 396
Gibson, J. D., 622
Gilbert, G. R., 417
Gile, R. E., 1394
Gillespie, D. T. C., 635
Gillin, J. A., 984
Gilmartin, T., 706
Gilmartin, T. H., 1873
Ginsburg, A., 115
Giordano, A., 470
Givaudon, J., 721
Glasgow, A. R., 283
Glasgow, A. R., Jr., 286, 1488
Gleason, A. H., 1289
Glover, R. C., 706
Glowacki, W. L., 417
Goddin, C. S., 456
Godsby, J., 606
Goepfert, O., 736
Goldblatt, L. A., 654
Goldfinch, D. A., 1065
Goldstein, R. F., 1337, 1906
Goldstein, T., 1325
Gollin, G. J., 137, 138, 139, 140
Gonikberg, M. G., 1487
Gonzalez, R. J., 1644
Goode, C. J., 459
Goodson, L. B., 876
Gooding, R. M., 605
Gordon, A. S., 590
Gordon, B. E., 1319
Gordon, K., 1871
Gordon, R. R., 889
Gordon, S. H., 461
Gordy, W., 127, 1880
Gorin, E., 417, 615, 876
Gorin, M. H., 417, 591, 593, 1289
Gorshkov, G. V., 1395
Gosselin, A., 757
Gouin, F., 1742
Gould, D. W., 274
Goulding, H. D., 1513
Goulding, H. G., 1717
Gount, J. G., 1689
Graff, R. A., 1099
Granberg, A. J., 718
Grant, B. F., 223
Grant, J., 1047
Grant, P. A., 1752
Gray, G. R., 1603, 1809
Gray, R. L., 367
Green, A. D., 121, 417
Green, W. P., 456
Greenburg, R. B., 876
Greene, F. C., 773
Greenfelder, B. S., 417, 876
Greenland, K. M., 1875
Gregory, J. N., 452, 700
Grenko, J. D., 727
Gresham, W. F., 876
Griep, E. F., 456
Griesinger, W. K., 417, 876
Griffin, J. R., Jr., 1202
Grilly, E. R., 280
Grim, R. E., 1721
Griswold, J., 114, 658
Grodzinski, P. 143
Groff, J., 461
Groote, M. de, 876, 1289
Gross, H. E., 1000
Gross, H. H., 876
Gross, R. J., 255
Grosse, A. V., 1289, 1321
Grubb, H. M., 1289
Gruver, R. M., 534
Gsovsky, V., 952
Guilleuin, V., 52
Gundy, C. E. van, 174
Gunning, H. E., 1697, 1698
Gurney, C., 1703
Gustafson, H. W., 1097
Guthrie, R. K., 1043
Gutzeit, C. L., 876
Guyot, R., 1220

Haase, H. F., 541
Habeshaw, J., 876
Hachmuth, K. H., 1289
Haensel, C., 1202
Haensel, V., 121, 417
Hagen, C., 1138
Hagerbaumer, W. A., 869
Hagethorn, N. E. M., 131
Halbouty, M. T., 1553, 1756
Hale, C. H., 657
Halford, R. S., 1696
Hall, A. C., 416

Hall, A. S. Jr., 1916
Hall, C. C., 409, 602, 1870
Hall, G. W., 706
Hall, H. J., 876, 1289
Hall, L. G., 876
Hall, R. T., 638
Hall, T. A., 1864
Halsey, G., 1111
Halverson, L. K., 398
Hamblet, C. H., 1689
Hamil, A. B., 1589
Hamilton, J. P., 417
Hanford, W. E., 1689
Hanna, W. S., 427
Hansley, V. L., 607
Hanson, G. H., 434
Hanson, T. K., 1315
Hardenberg, H. J., 73, 1738
Hardin, C., 1756
Hardin, G. C., 1553
Hardy, J. K., 298
Harford, W. E., 876
Harkins, W. D., 122
Harper, O. D., 707
Harrington, P. J., 266
Harris, G. C., 670
Harris, S., 965, 1158, 1798
Harrison, J. M., 597
Hart, E., 718
Hart, M., 1803
Harte, C. R., Jr., 391
Hartley, A. C., 471
Harts, H. W., 262
Haskell, N. B., 876
Hassebroek, W. E., 216
Hassel, O., 1493
Hasselmann, K. H., 1799
Hastings, S. H., 121, 417, 1330
Hastings, W. K., 201
Hatch, G. B., 1689
Hatch, L. F., 417
Haupt, H. W., 1805
Hawthorne, W. P., 417, 876
Hayter, B., 1689
Heald, K. C., 1347
Heard, L., 417
Heath, J. L., 396
Heath, W. A., 61, 361, 552, 1044
Heaton, W. B., 417, 1315
Heck, E. T., 536, 538
Heigl, J. J., 417, 1329
Heiland, C. A., 205
Heinemann, H., 876
Heller, W., 1702
Helmers, C. J., 121
Heltzel, W. G., 94, 95
Hemsley, H. L., 1410
Henderson, L. M., 876
Hene, E., 876, 1689
Henry, R. W., 876
Henshelwood, C. N., 606
Hepp, H. J., 417, 613, 876, 1202, 1289
Herrington, K. D., 628
Hersberger, A. B., 417, 896
Hershberg, E. B., 670
Herthel, E. C., 417
Hervert, G. L., 604
Hessels, W. J., 1203
Hickel, A. E., 469
Hickinbottom, W. J., 1188, 1886
Higgins, J. H., 718
Hildebrand, J. H., 1887
Hill, F. B., Jr, 732
Hill, F. C., 1202
Hill, H. M., 1302
Hill, L. R., 419
Hill, R. H., 876
Hill, T. L., 281
Hill, W. B., 1621
Hilseweck, W. J., 1755
Hinckley, J. A., Jr., 1326
Hinden, S. C., 1321
Hineline, H. D., 876
Hinson, H. H., 945
Hipple, J. A., 1701
Hirsch, J. H., 272, 589
Hirschler, A. E., 123
Hobart, H. P., 1689
Hock, R. L., 809
Hockberger, W. G., 722
Hodges, C. E., 1905
Hoerger, E., 1335
Hoeven, Van Der H., 1476
Hoffmeister, W. S., 69
Hoge, A. W., 109, 404, 1481
Hohnstine, J. T., 417
Holaday, W. N., 1131
Holbrook, G. W., 550
Holligan, P. T., 1341, 1504
Holloway, C., 600
Holm, H. K., 121
Holroyd, R., 1289
Holt, B. M., 1689
Holt, P. H., 1202
Hooser, D. B., 706, 707
Hoover, H., Jr., 996
Horeczy, J. T., 876
Hornbacher, H. G., 1332
Horne, A. N., 856
Horsley, L. H., 876
Horton, A. A., 1072
Horton, A. W., 876, 1072, 1305
Horton, C. W., 187, 969, 977
Horvitz, L., 184
Horwitz, W., 1898
Hoskings, H. A., 1618
Hoss, R. L., 551
Houghland, G. S., 266
Houghton, J. L., 1894
Houlton, H. G., 144
Houndry, E. J., 121
Howard, P. A., 718
Howe, H. V., 939
Howe, L. S., 417
Howes, D. A., 121, 866, 1526
Hoylman, H. W., 991
Hoyte, W. N., 876
Hudson, L. C., 66
Hudson, N. L., 1343
Huetz, J., 1106
Huff, L. C., 121, 876, 1289
Huffman, H. C., 876, 1289
Huffman, H. M., 610, 1292, 1293, 1294
Hughes, C. H., 1072
Hughes, E. C., 121, 417, 727, 876, 1072, 1289
Hughes, R. V., 231, 360, 535, 554, 555, 816, 818, 819, 826, 1037, 1038, 1275, 1429
Hughes, T. P., 876
Hull, C. M., 1202
Hull, W. 121, 417
Hume, G. S., 87, 1237
Hummel, F. E., 1254
Humphreys, C. J., 1076
Hunter, A. L., 506
Hunter, B. F., 1689
Hunter, E., 1072
Hunter, T. G., 125, 431
Hurka, V. R., 732
Hurley, P. E., 121
Husted, C. A., 707
Hutchinson, A. J., 266
Hutchinson, A. J. L., 1202
Hutchinson, F. E., 706
Huxley, T. F., 1909
Hyatt, D. L., 1550
Hyde, H. Y., 876
Hyde, J. F., 1202

Ibach, G. A., 1289
Imlay, R. W., 687
Ipatieff, V. N., 110, 417, 727, 876, 1202, 1308
Ippen. A. T., 390
Ipstieff, V. I., 121
Ireland, H. A., 1725
Irwin, J. L., 1171, 1833
Ivanovszky, L., 145
Iverson, J. O., 876
Ives, G. O., 510, 693, 777 1770, 1834, 1837
Jacini, G., 1912
Jackson, W. J., 540, 1022
Jacque, L., 721
Jaknig, C. E., 417
Jakovsky, J. J., 1346
James, J. R., 1472
Japes, D. H , 876
Jasper, J. J., 628
Jenkins, F. W., 707
Jenkins, G. I., 876
Jenkins, H. D., 243
Jenkins, V. N., 1202
Jenny, W. P., 1156
Jensen, H., 198, 199
Jillson, W. R., 1745
Jodell, G. E., 876
Joffe, B. V., 444
Johansson, S. C., 876
Johns, H. F., 707
Johnsen, S. E. J., 1331
Johnson, E. A., 1013
Johnson, E. R., 876
Johnson, G. C., 609, 1291
Johnson, H. L., 876
Johnson, J. H., 1133
Johnson, K. H., 1406
Johnston, D., 1001
Johnston, H. L., 280
Jones, C. F., 417
Jones, E. N., 260, 347, 1016, 1027, 1029, 1265, 1266, 1267
Jones, J. P., 121, 229, 417, 537
Jones, L. C., Jr., 1318
Jones, P. J., 232, 372, 559, 561, 562, 563, 564, 565, 1039, 1040, 1041, 1042, 1166, 1167, 1168, 1274, 1431, 1432
Jones, W. B., 1759
Jones, W. J., 1206
Joone, G. C., 417
Jordan, J. F., 1100
Joukou, V. A., 959
Jura, G., 122
Justice, W. H , 260, 347, 542

Kadmer, E. H., 467
Kahn, A., 1237
Karabinos, J. V., 612, 1304
Karle, J., 126, 1312, 1904
Kassel, L. S., 1289
Kastrop, J. E., 50, 790
Katan, L. L., 1200
Katz, D. L., 434, 1438
Katz, D. L. V., 1689
Katz, J. J., 1300
Kaveler, H. H., 217
Kaveyev, M. S., 1243
Kay, W. B., 625, 1311
Kaye, J., 1715
Kazarnovskaya, B. E., 1401
Kearley, K. K., 876
Keating, G. H., 876
Keeling, W. O., 417
Keenan, J. H., 1715
Keeser, B., 1289
Keiser, B., 876
Kejla, —, 1193
Keller, B. M., 962
Kellett, J., 121, 724, 876
Kelly, A. A., 876
Kelly, C. L., 292, 666
Kelly, E. J., 1289
Kelly, W. A., 772
Kellogg, F. N., 48
Kelso, C. D., 1202
Kelso, G., 1187, 1481
Kemler, E. N., 357, 1824
Kemp, H. S., 434
Kendall, J. M., 985
Kennedy, H. T., 41, 356, 707, 813
Kent, F. A., 121
Kent, J. W., 1328
Keplinger, C. H., 363, 364, 365
Kersten, G. V., 218
Kettering, C. F., 1498
Kielhorn, H. F., 876

Kilpatrick, J. E., 730, 1075
Kimball, T. B., 1202
Kimbrell, W. B., 1398
Kind, F., 872
Kind, I. F., 726
King, R. H., 774
Kingham, F. E. T., 419
Kingston, B., 547
Kinley, J., 1608
Kinley, M. M., 1608
Kinneberg, I. H., 1289
Kintz, G. M., 989
Kirk, J. H., 121
Kirkbride, C. G., 580
Kirkpatrick, J. B., 876
Klaus, K., 204
Klecka, M. E., 658
Klevens, H. B., 1700, 1702
Kling, R., 1518
Knight, E. R., 667
Knipling, E. F., 474
Knowlton, D. R., 557
Knudsen, H. L., 1314
Koepf, E. H., 1098
Koester, E. A., 74, 1736
Kogbetliantz, E. G., 972
Kollen, M. H., 876
Kolthoff, I. M., 623
Komareswky, V. I., 1298
Korobkov, L. A., 180
Korpi, K. J., 731
Kosygin, G. A., 934
Kothny, G. L., 789, 794, 1007, 1008, 1013
Koussakov, M., 1112
Kowlaski, F., 707
Kramers, H. A., 278
Krampert, E. W., 1359
Krasnow, S., 706, 1013
Kreulen, D. J. W., 418
Krienke, C. F., 435
Kronberger, H., 1876
Kroon, B. C., 665
Krueger, M. L., 29
Kruse, W. E., 876
Kuck, J. F. R., Jr., 1304
Kuhl, P. E., 876
Kuhn, C. S., Jr., 121, 417, 591
Kurtz, S. S., Jr., 123
Kutz, W. M., 621

Lacey, W. N., 614, 731
LaClair, J. B., 650
Lahee, F. H., 67, 1352, 1726
Laigret, J., 1690
Laird, H. C., 348
Laird, W. M., 1732
Laitinen, H. A., 632, 633
Lake, G. R., 876, 1289
LaLande, W. A., Jr., 876
Lambert, H. W., 97
Lancashire, E. P., 1199
Landen, W. E., 309
Landes, K. K., 5
Landoni, A., 380, 381, 763
Landrum, H. B., 707
Lane, H. W., 929
Lane, S. C., 121
Lang, W. B., 1748
Langer, A., 1088
Langseth, A., 1493
Lankelma, H. P., 620, 1689
Lantz, V., 653
Larson, C. M., 888
Lassiat, R. C., 403
Latchum, J. W., Jr., 727
Latta, R., 473
Laudon, L. R., 1766
Lauenstein, R. L., 1021
Lauer, J. L., 642
Laughlin, K. C., 876
Lauterbach, R. A., 406
Lauterback, R. E., 867
Lawn, G., 1070
Lawry, T. F., 374, 558
Lawton, H. C., 225, 1426
Lay, R. L., 189

M M

Lazar, A., 417
Leach, S. J., 742
Leamon, G. F., 1859
Lee, E. C., 876
Lee, J. H., 639
Lee, R., 869
Leffer, F. W., 417
Legatski, H. R., 1202
Legrand, C., 1494
Legrand, J. C., 1808
Lenn, N. F., 876
LeRoy, D. J., 1327
Lesser, M. A., 149
Lethersich, W., 897
Levin, H., 636
Lewis, C. F., 1251
Lewis, C. J., 655
Lewis, J. A., 1201
Lewis, J. O., 221
Lewis, R. H., 903
Leyland Cole, L. W., 1218
Liatkovskaya, N. M., 1395
Lieber, E., 727, 876, 1202, 1289
Lien, A. P., 417
Lilley, H. S., 1505
Lindahl, E. J., 415
Lindahl, J. P., 391
Lindblad, E. N., 1420
Lindquist, A. W., 474
Lindsay, C. A., 532
Linford, H., 1289
Linn, C. B., 876, 1202, 1289
Linnett, J. W., 1691
Lipkin, M. R., 631
Littman, E. R., 121
Lloyd, E. R., 1813
Lloyd, L. E., 1332
Lloyd, W. S., 339
Lochte, H. L., 1303
Lockett, J. R., 768
Loeb, H. D., 876
LoeHerle, G. J., 1750
Loeser, E. H., 122
Loetterle, G. J., 83
Logan, L. J., 1727
Logue, L. L., 1380
Lomax, E. L., 1840
Lomer, T. R., 1084
Long, A. B., 376
Long, L. H., 734
Lonkomsky, S. A., 1202
Love, R. M., 1320
Loveley, H. R., 36
Lowe, R. E., 876
Lowell, A. L., 1121
Lowenstein-Lom, 1193
Lower, E. S., 1913
Lozier, P. De, 1433
Luàcas, E. L., 1072
Ludi, W. C., 414
Lugaresi, A., 883
Lundberg, H., 1381, 1795
Luntz, D. M., 109, 404
Luten, D. B., Jr., 876, 1202
Lykken, L., 634, 641
Lyle, H. N., 1606
Lynch, C. S., 876
Lynton, E. D., 1777

McAlevy, A., 1689
McAllister, S. H., 121, 876
McBain, J. W., 146, 1910
McCalloch, T. B., 1289
McCarver, H., 947
McCaslin, L. S., 1651, 1821
McCaslin, L. S., Jr., 1591, 1823
McClain, H. M., 1276
McCleary, R. F., 876
McClennan, L. W., 751
McClintock, F. A., 297
McCloy, W. L., Jr., 350
McCollum, L. F., 1450
McCoy, P. E., 1289
McCulloch, T. B., 417
McCullough, O. J., 707
McDaniel, E., 1252
McDowell, C. A., 1078

McGaha, S. W., 1800
McGarry, R. J., 1411
McGee, D. A., 243
McGlamery, W., 1759
McGlone, J. F., 707
McIntosh, A. J., 1719
McKee, A. H., 968
McKee, E. D., 683
McKetta, J. J., 1438
McKinley, C., 756
McKinney, A. W., 457
McLemore, R. H., 528
McNab, J. G., 121, 876, 1289
McReynolds, L. A., 646, 1902
McWilliams, L. L., 352
Maass, R., 406, 867
MacCracken, C., 1215
MacDonald, M., 400
MacDonald, R. R., 353
Macfadyen, W. A., 837
Mack, C., 428, 429, 430
Mackay, J. S., 876
Madden, A. H., 474
Mahan, J. S., 876
Maher, J. C., 17
Maier, A. R., 706
Maimin, Z. L., 180
Mair, B. J., 284
Malakoff, H. L., 477
Mann, G. L., 871
Manuel, R. W., 1289
Mapstone, G. E., 643
Maragon, E. A., 655
Marancik, J. C., 876
Mardel, E., 876
Marisic, M. M., 121
Mark, B., 1447
Mark, F. L., 121
Markle, M. G., 745
Marley, H. R., 876
Marriott, R. H., 120
Marschner, R. F., 876
Marsden, S. S., 1313
Marshall, D. L., 1416
Marshall, E. T., 121
Marshall, R. W., 212
Martens, J. H. C., 1559
Martin, C. C., 631, 642
Martin, D., 1277
Martin, E. J., 876
Martin, H. Z., 876
Martin, J. B., 644
Martin, W. F., 811, 1017
Marty, P., 1605
Marukjan, E. M., 1191
Marukjan, G. M., 1190
Marusic, M. M., 876
Mason, R. B., 417, 1202
Masters, R. W., 1814
Masterson, E. C., 678
Mater, R. G. De La, 707
Matteson, R., 427
Mattix, E. D., 1874
Mattox, W. J., 121, 1289
Matuszak, M. P., 121, 622, 876
Mauso, O. G., 1202
Mavity, J. M., 604, 876
May, D. R., 632
May, D. T., 823
May, R. L., 876
Mayland, B. J., 1289
Mayland, H. C., 727
Mayo, F., 1080
Mayo, F. R., 1299, 1300
Mazurkiewicz, A. G., 542
Meadow, J. R., 876
Meenert, R. N., 876
Meier, H. H., 417
Meilert, D. V., 745
Meinkat, R. N., 1202
Mekler, L. A., 876
Meldrum, R. F., 876
Ment, J. de, 978
Menzie, D. E., 807, 1259
Mercier, V. J., 1157
Mertz, V., 876
Merwin, W. J., 1289

Metler, A. V., 630
Metrot, R., 442
Meyer, A., 1225
Meyer, J. B., 707
Meyer, R. E., 121, 1072
Meyerstein, W., 1094
Mighton, C. J., 732
Miles, C. B., 591
Miles, S. H., 1333
Miller, B. R., 1806
Miller, E. F., 1131, 1500
Miller, K. T., 800
Miller, L. E., 824
Miller, R. J., 1289
Millington, J. W., 706
Mills, F. W., 123
Mills, R. B., 99
Minervini, C., 290, 451
Minne, J. L. Van der, 1114, 1882
Mitchell, G. S., 599
Mitchell, P. J., Jr., 417
Mitchell, R. G., 1072
Mohr, A. C., 876
Moignard, L. A., 876
Moncrief, E., 344
Mond, A. L., 1689
Monnot, G., 1220
Monroe, G. S., 727
Monroe, W. H., 13
Monson, L. T., 351, 707, 740, 804
Montgomery, C. W., 597, 598, 621, 1202
Montgomery, J. V., 876
Montgomery, P. A., 82
Moody, G. B., 71, 1728
Moody, J. D., 1731
Moore, L. A., 1741
Moore, P. H., 470, 743, 884, 1706, 1865
Moorman, A. R., 876
Moran, T. G., 15
Morey, G. H., 417, 876
Morgan, F., 236, 800, 1414
Morgan, J. D., 876, 1094, 1289, 1202
Morgan, J. S., 1013
Morgan, P., 632
Morgana, M., 670
Moriarty, F. C., 449
Morris, G., 974
Morris, J. R., 876, 1289
Morris, R. C., 876, 1315
Morris, W. S., 375
Morrison, G. O., 727
Morse, R. A., 825, 1278
Morway, A. J., 876, 1289
Mosher, H. S., 672
Moskow, M., 424
Moss, M. L., 638
Moult, E. S., 1509
Mounce, W. D., 1013
Moureau, H., 276
Mowrey, L. D., 707
Moyer, 1421
Muffly, G., 982
Muliane, J. J., 230
Mullins, B. P., 420, 892
Munday, J. C., 1289
Murphy, D. A., 1013
Murphy, E. T., 286, 729, 1074
Murray, F. F., 43
Musher, S., 876
Muskat, M., 236, 800, 1025, 1045, 1414
Musselman, J. M., 121, 1689
Myers, C. G., 1702
Myers, G. D., 1481
Myers, N. F., 121
Myles, J. R., 417
Mysels, K. J., 1313, 1899

Naragon, E. A., 727, 1289
Narvarte, P. E., 992
Neilson, R. B., 1226
Neilson, R. F., 807, 1259
Nelson, F. L., 1500
Nelson, J. S., 633
Nelson, W. L., 96, 101, 102, 106, 134, 259, 263, 264, 265, 393, 394, 436, 450, 584, 660, 716, 741, 861, 864, 896, 1057, 1063, 1064, 1073, 1089, 1179, 1180, 1196, 1288, 1477, 1684, 1685, 1708
Nelson, W. R., 862, 863
Nettleton, L. L., 942
Neubauer, E. T., 1060, 1178, 1474
Nevolin, N. V., 1374
Nevzgljadov, V. G., 1205
Newall, H. E., 419
Newman, W. R., 586
Newton, E. P., 876, 1202
Newton, R. H., 876
Nichols, E. A., 941, 1793
Nicholson, E. W. S., 876
Nickle, C. O., 692, 775, 1761, 1762
Nielsen, R. F., 224, 1031
Nissan, A. H., 890, 1080, 1892
Nixon, A. C., 1202
Nixon, I. G., 727
Noble, E. B., 1345
Noble, F. G., 876
Noll, H. D., 109, 1187
Noone, M., 854
Nogbisarath, H., 24
Norelius, R. G., 1423
Norman, H. S., 78, 93, 523, 769, 770
Norrish, R. G. W., 734
Norton, F. J., 1047
Nottorf, H. A., 118
Norway, H. L., 121
Novello, F. C., 670
Nowels, K. B., 233
Nowlan, H. H., 1546
Noyes, R. M., 1335
Nugent, L. E., Jr., 766
Nutting, H. S., 876
Nygaard, E. M., 417
Nysewander, C. W., 411, 876

Oakley, E. H., 876
Oberfell, G. C., 447
Oberg, C. H., 1814
Oberholzer, V. G., 452
Oblad, A. G., 417, 593, 615
O'Brien, A. S., 632, 633
Ocon, C. L., 876
Ocon, E. A., 876
O'Connell, H. E., 387
Odell, W. W., 1202, 1289
Offman, P. E., 960
Offutt, W. C., 272, 273, 587, 588, 589
O'Kelly, A. A., 116, 121, 724, 876, 1072
Olcott, P., 80, 1830
Oldach, C. S., 640, 647, 648
Oldham, W. J., 1883
Oldroyd, D. M., 654
Olds, R. H., 1419
O'Leary, C. M., 1013, 1248, 1392.
Oliphant, S. C., 1413
Oliveira, A. I. de, 382
Oliver, G. D., 1294
Opdyke, E. G., 434
Openheimer, V., 34
Ospina-Racines, E., 764
Ossipova, A. J., 958
Ostergaard, P., 272, 273, 587, 588, 589
Otto, F. B., 1072
Owen, J., 1202
Owen, J. J., 417
Owner, F. M., 301, 302, 759
Owsley, D., 1407
Ozanne, H., 713, 1576

Packie, J. W., 1389
Padgett, A. R., 1320
Padgett, J. C., 1255
Page, H. W., 320
Page, R. K., 1122
Paleni, A., 1508
Panchenkov, G. M., 1287, 1480
Parker, B. H., 1724
Parker, I. M., 257
Parker, J. S., 1213
Parker, R. L., Jr., 876
Parker, S. S., 1062
Parquet, M. du, 1220
Parsons, R. L., 1420
Partridge, W. A., 1202
Patrick, C. W., 121
Patterson, J. A., 417, 876
Patterson, R. J., 727
Patton, E. C., 1032
Patton, L. T., 688
Pavlic, A. A., 629
Payne, G. L., 1202
Payne, J. W., 1202, 1289
Peabody, G., 965
Pearse, B. H., 1746
Peavy, C. C., 1481
Peck, E. B., 876
Pedersen, C. J., 1289
Pederson, C. G., 417
Peel, D. H. P., 876, 1289
Peirson, J. G., 1120
Pellam, J. R., 1704
Penn, W. S., 475, 909, 1115
Perkins, H. W., 1607
Perkins, R. B., 398
Perrin, M., 592, 737
Perrine, J. H., 876
Perry, S. F., 413
Pesez, M., 1486
Peters, E. D., 634, 641, 1325
Peters, J. G., 121, 718, 876
Peters, J. W., 207
Peterson, L. F., 1260
Peterson, W. H., 417
Petrov, A. D., 1067
Petry, T. A., 121, 1202
Petty, O. S., 698
Pevere, E. F., 876, 1689
Peyton, G., 938
Pezzaglia, P., 876
Pfister, R. J., 234, 345, 1429
Phenix, B. C., 119
Phinney, J. A., 870, 1484
Phipps, H. K., 258
Pickard, P. L., 1303
Pickett, A. D., 1202
Pickett, D. L., 899
Pierce, J. Q., 121
Pilz, G. D., 147
Pines, H., 623, 624, 876, 1202, 1308
Pinfold, E. S., 850
Pinion, T. N., 706
Pipparelli, E., 290, 451
Pirson, S. J., 55, 981
Pitzer, K. S., 285, 619, 730, 1075, 1081
Plucker, J., 724, 876
Plummer, F. B., 237
Plyler, E. K., 1076
Pokrovskaya, E. S., 1485
Polk, A. C., 1417
Pomeroy, H. H., 1899
Pont, du H. I., 1202
Poole, R., 1289
Poore, J. N., 548, 549, 815, 1602
Porsche, F. W., 637
Pound, G. S., 1689
Powell, H., 889
Powell, T. M., 727
Power, H. H., 1128
Powers, P. O., 671
Prange, F. A., 167
Pratt, W. E., 933
Pray, H. A., 541
Prettre, M., 592, 1195
Price, C. F., 1298
Price, P. H., 9, 932, 1559

Price, W. A., 23, 1749
Price, W. C., 1888
Probert, R. P., 1083
Prouty, C. E., 28
Pruett, H. T., 379
Prutzman, P. W., 1289
Putnam, S. T., 638, 670, 1306
Putz, T. I., 491
Putz, T. J., 918
Pyke, R., 1327

Quarendon, R., 1090, 1211, 1707
Quartel, de H. J. M. W., 799

Radford, H. E., 1400, 1810
Rae, C., 556
Ragatz, E. G., 268, 399
Ragland, D., 211
Ramage, A. S., 876
Rankin, C. H., 332
Rasemuss, J. E., 1458, 1835
Rasmussen, R. S., 277, 1694, 1695
Raucourt, M., 451
Ravitz, L., 1573
Ray, F. E., 1289
Ray, G. C., 876
Raymond, C. L., 412
Read, A., 705
Read, D., Jr., 876
Reamer, H. H., 731, 614
Records, E. H., 1289
Redcay, A. K., 876
Reed, H. C., 1689
Reed, J. C., 30
Reed, L. C., 32
Reed, P., 513, 515, 577, 857, 937, 951, 1002, 1239
Reed, R. M., 603
Reenhardt, F. E., 876
Reeves, E. D., 1289
Reeves, F., 89, 1789
Reger, D. B., 1558
Reid, E., 601
Reid, J. C., 894
Reiff, O. M., 417
Reis, M. T., 467
Reis, T., 432
Reiter, W. A., 1723
Renfro, H., 1615
Reynolds, E. H., 1070
Reynolds, J. J., 100
Rich, H., 229
Rice, O. K., 1890
Richards, A. R., 1322
Richards, H. G., 1743
Richards, P. H., 146
Richards, R. B., 417, 1072
Richards, T. C., 974
Richardson, E. G., 935
Richardson, J. A., 268, 399
Richter, C., 727
Ricker, N., 188
Ridley, C., 680
Riecke, S. C., 876
Riester, W. F., 392
Rigamonti, R., 1911
Riggs, C. H., 1406
Ringgenberg, H., 895
Ringham, C. R., 876
Rippeteau, W. L., Jr., 1289
Riske, T. H., 1100
Rittenhouse, G., 8
Rivoal, G., 276
Robert, L., 443
Roberti, G., 290, 451
Roberts, C. H. M., 727
Roberts, E. N., 876
Roberts, G., 870, 1484
Roberts, T. G., 25
Robertson, A. E., 876, 417
Robinson, D. Van, 69
Robinson, J. V., 1101
Robinson, R., 878, 1692
Robinson, W. B., 191
Robotham, W. A., 913
Rocchini, A. G., 121
Rockwell, R. A., 1858
Roethell, B. E., 906
Rogers, D., 228
Rogers, D. T., 121, 876
Rogers, M. C., 1491
Rollins, F. S., Jr., 417
Roman, I., 995
Romberg, J. W., 1092
Rook, C. G., 103
Rose, G. F. R., 168
Rose, J. R., 1389
Rosenbaum, E. J., 642
Ross, W. E., 121, 876, 1289
Rossini, F. D., 283, 284, 285, 286, 729, 1074, 1488
Rostler, F. S., 1202
Rout, A. E., 876
Routson, W. G., 1289
Rowland, C. S., 1297
Rubin, L. C., 876
Rueggeberg, W. H. C., 115
Rupp, W. H., 707, 1289
Russell, A. S., 1310
Russell, H. M., 344
Russell, R. G., 236
Rust, F. F., 1289
Rutherford, J. R., 1289
Ruthruff, R. F., 1202
Ryder, H. M., 1280
Rymer, T. B., 1896

Sachanen, A. N., 116, 876, 1072
Sack, H. A., 1209
Sadler, C. G. A., 120
Sage, B. H., 614, 731, 1419
Sager, F., 594
Saito, E., 1489
Salathiel, R. A., 417
Salnikov, I. S., 1600
Salvi, G., 1506
Sanders, P. A., 732
Sanderson, J. O. G., 690
Sanderson, R. T., 727
Sandidge, J. R., 10
Sandoz, T. H., 1595
Santiago, J. J., 1013, 1047
Saurino, B., 383
Savitz, C. W., 1013
Savoy, M., 1289
Savoy, M. G., 1299
Sawtelle, F. G., 531
Scafe, E. J., 582
Scarth, V., 417
Schaad, R. E., 1289
Schade, H. A., 311
Schaefer, H., 1415
Scheeline, H. W., 876, 1289
Scherbatskoy, S. A., 698, 1873
Scheuermann, L. N., 377
Schildknecht, C. E., 756
Schiller, H., 66
Schindler, H., 876
Schmerling, L., 110, 417, 727, 876, 1202, 1689
Schmitkins, G. E., 1202
Schmitt, A. C., 876
Schmitt, P., 721
Schmuck, R. F., 615
Schnabel, — 1193
Schonberg, J. R., 1289
Schou, H., 876
Schrader, L. W., 1289
Schroeder, H. O., 474
Schuetz, R. D., 1296
Schulz, J. S., 135, 136, 454
Schulze, W. A., 121, 417, 876
Schuppli, H. M., 40
Schussler, R. W., 1297
Schwartz, M. L., 1289
Schweitzer, P. H., 310, 1517
Scott, C. H., 718
Scott, D., Jr., 1434
Scott, F. L., 45
Scott, P. H., 718
Scrafford, B., 84, 1753
Scrivener, W. C., 1013
Sedlak, V. A., 729, 1074
See, M. J., 391
Seeley, S. W., 203
Segelhorst, A. L., 706
Selfridge, F. W., 121
Semenido, E. G., 1710
Semmola, E., 290, 451
Semon, L., 295
Sen Gupta, N. C., 705
Sens, R. F., 706
Sensel, E. E., 1289
Serijan, K. T., 611, 612
Serruys, M., 1224, 1497, 1523
Sewell, B. W., 1013
Seyfried, W. D., 121, 417, 1320, 1330
Shabaker, H. A., 121, 1689
Shankland, R. Y., 417, 876
Shapiro, A., 66
Sharp, J. W., 706
Sharp, L. G., 417
Sharp, R. C., 212
Shaw, M. C., 1060, 1474
Shchelkachev, V. N., 183, 1253
Sheets, M. M., 684
Shelby, T. H., Jr., 83, 178
Shelton, J. S., 15
Shelton, P. L., 1023
Shephardson, R. M., 417, 876
Shepherd, G. F., 1757
Shepherd, M., 1091, 1317, 1492
Sheppard, C. W., 1
Sheppard, N., 1208
Shimansky, L. F., 397
Shimer, J. M., 341
Shinomiya, S., 706
Shoemaker, B. H., 121
Shoemaker, D. P., 1335
Shokal, E. C., 876
Short, E. H., 891, 1003, 1046, 1393, 1554
Short, E. H., Jr., 47, 524, 1005, 1010, 1385, 1596, 1601, 1614, 1802
Short, G. H., 417
Showalter, J. C., 1289
Shrapnel-Smith, E. S., 675
Shreeve, C. A., 456
Shreve, C. W., 1899
Shvemnerger, N. A., 326
Siecke, P., 876
Sigal, J., 953
Silverman, D., 706, 1013
Simonetta, M., 445
Simpson, T. P., 1202, 1289
Sims, J. J., 1689
Singleton, H. M., 1320
Sinn, V., 1087
Sinoley, E. R., 1479
Siskind, D. I., 44
Skeels, D. C., 979
Skelton, W. E., 748
Skinner, D. A., 876
Skinner, J. W., 179
Skogan, V. G., 1491
Slezkin, N. A., 465, 1104, 1105
Sloss, L. L., 182, 1732
Small, A. D., 963
Small, W. N., 835
Smallwood, H. M., 876
Smith, A., 98
Smith, A. D., 876
Smith, C. D., 1751
Smith, E. A., 405, 876, 1113
Smith, G. H., 1313
Smith, G. W., 772
Smith, H. G., 121, 718, 876, 1289
Smith, J. E., 417
Smith, K. W., 817
Smith, M. A., 876, 1202
Smith, N. C., 936
Smith, R. H., 1417, 1620
Smith, R. V., 57
Smith, S., 1412
Smith, S. L., 1870
Smith, W. M., 1202
Smith, W. R., 1290

Smoliansky, M., 1108
Sneddon, R., 378, 702, 1051
Snodgrass, C. B., 1009
Snow, R. D., 876
Snuggs, J. F., 868
Solomen, E., 876
Somers, J. J., 876
Sowerwine, E. I., Jr., 1202
Spain, H. H., 1617
Spalding, D. P., 672
Sparks, W. J., 1289
Spink, J. A., 900
Spitzer, R., 619, 1293
Spivey, R. D., 25
Sprung, M. M., 876
Spurr, R. A., 611
Squires, F., 235, 1430
Stach, L. W., 1787
Stair, R., 1076
Standing, M. B., 1197, 1420
Starkweather, H. W., 732
Starr, C. E., 722
Starret, H. A., 718
Steacie, E. W. R., 1697, 1698
Steele, C. T., 121
Steenis, J. Van, 1203
Steiner, H., 876
Steiner, K., 455
Steinitz, E. W., 142
Steingr, H., 1869
Stelzer, W., 706
Stepantzeva, T. G., 1485
Stephens, F. M., 727
Stephenson, E. A., 1035, 1036
Sterne, W. P., 1139, 1384
Sterrett, E., 358, 1012, 1386, 1403
Stewart, A. H., 754
Stick, J. C., 1423
Stieltjes, F. H., 131
Stipp, T. F., 689
Stirton, R. I., 1689
Stock, C. R., 1202
Stockman, L. P., 1235
Stokes, J. C., 706
Stokes, J. J., Jr., 1310
Stoneman, A. C., 417
Stoppel, A. E., 595
Stout, C. E., 545, 1273
Stovall, W. S., Jr., 1613
Stover, W. A., 876
Strakhov, N. M., 955
Strang, L. C., 1202
Stratton, E. F., 1808
Strawn, L. R., 727
Street, F. A., 1161
Streets, R. E., 1901
Streiff, A. J., 283, 729, 1074, 1488
Stribley, A. F., Jr., 1202
Strien, R. E., 672
Strong, R. G., 1055
Struth, A. J., 829
Stuart, A. H., 141, 462, 463, 898, 1210
Stuart, R. W., 793
Stueve, W. H., 395
Stulken, E. J., 190
Suderman, A. W., 132
Sullivan, A. P., 1289
Sullwood, H. H., 505
Sumerford, S. D., 417
Sumner, G. L., 598
Suter, H. H., 681
Sutherland, G. B. B. M., 1208
Sutton, A. M., 1836
Sutton, A. N., 250, 1127
Sutton, F., 1059
Sutton, F. A., 35
Sutton, M., 144
Swaney, M. W., 417
Swearinger, J. E., 411
Swenson, R. A., 1689
Swerdloff, W., 1289
Swesnik, R. M., 1358
Swift, G., 1873
Swindells, J. F., 1096
Sykes, J. K. W., 606
Szwarc, M., 1881

Tadayon, J., 889
Tait, H. C., 1072
Taliaferro, H. R., 391
Taliasferro, D. B., 1043
Targ, S. M., 1103, 1104
Tartarani, G., 407
Taso, P. H., 1864
Tate, C. C., 1289
Taylor, H., 19, 1354, 1734
Taylor, H. S., 417
Taylor, J., 974
Taylor, J. K., 739
Taylor, M. O., 1025
Taylor, R. C., 1323, 1324, 1689
Taylor, R. G., 706, 707
Taylor, W. G., 1822
Taylor, W. J., 280, 285, 1081
Tcherkezoff, N., 432, 433, 735, 880
Tears, C. F., 1479
Teichert, C., 520
Telfer, A. H., 695
Teplitz, A. J., 216
Termini, D. J., 284
Terwilliger, P. L., 819, 1435
Teter, J. W., 876, 1289
Thacker, C. M., 417, 876, 1289
Thaler, M. L., 437
Thalmann, H. E., 33
Thayer, C. H., 403
Theodorovitch, G. I., 961
Thomas, B., 219
Thomas, C. L., 121, 876, 1202, 1289
Thomas, H. D., 29
Thomas, R. W., 447
Thompson, B. F., 1860
Thompson, G. S., 1047
Thompson, H. W., 1207
Thompson, L. S., 181
Thompson, R. B., 727, 876, 1289
Thompson,—Van, 1099
Thomson, R. C., 929
Thornbury, S. G., 718
Thorner, M. E., 1289
Thornes, L. S., 876
Thornton, E., 1201
Thornton, O. F., 230, 370, 1416, 1820
Thule, E. W., 1202
Tilton, J. A., 722
Tiratsoo, E. N., 1242, 1774, 1784, 1785, 1786
Todd, J. D., 940
Todd, S. S., 1292, 1294
Tongberg, C. O., 876
Tooke, J. W., 879, 1316
Topchieva, K. V., 1480
Tordi, L., 282
Toussaint, J. E., 1402
Townsend, A. A., 1620
Trantman, C. E., 1047
Travers, W. J., 226
Traxler, R. N., 1092, 1093
Treseder, R. S., 1289
Triggs, W. W., 1689, 1072
Trillat, J. J., 1209, 1494
Trimble, H. M., 132, 288, 646, 1902
Tripp, R. M., 193, 194, 1791
Trishman, L. E., 1389
Troutman, W., 1070
Trumpler, P. R., 389
Tsao, U., 121
Tucker, A. J., 46, 330
Tucker, E. B., 1289
Tucker, R. C., 1559
Tuemmler, F. D., 641
Tunnicliff, D. D., 641
Turkevich, J., 417
Turner, B. B., 417
Tuttle, R. B., 679, 1071, 1181
Tuttle, R. C., 504
Tuyl, F. M. Van, 1724
Twigg, G. H., 421, 422, 423
Tyler, W. S., 121
Tyson, C. W., 1289

Ullig, H. H., 386
Umbgrove, J. H. E., 39
Umbgrove, J. H. F., 4
Underwood, A. J. V., 104, 105, 876
Upham, J. D., 121, 876
Usines, de Melle, 1072
Uspenskaya, N. J., 464

Vago, E. E., 1207
Vallaud, A., 1198
Varentzov, V. P., 133
Varr, A. F., 230
Vaughan, W. E., 1289, 1867, 1868
Velde, H., 448
Vellinger, E., 744
Veltman, P. L., 727, 876
Ventura, B., 450
Vereshchagin, L. F., 1487
Verter, De P. L., 876
Vialov, O. S., 170
Vichnievsky, R., 1220
Vietti, W. V., 230
Viland, C. K., 876
Villar, G. E., 476
Villey, J., 1107
Vincent, G. A., 410
Voiret, E. G., 469
Volman, D. H., 426
Voorhees, A., Jr., 876
Voorhees, V., 417
Voronin, N. I., 957
Vorst, J. P. Van, 700

Wachter, A., 1289
Wackher, R. C., 623, 624
Waddington, G., 1292
Wadley, E. F., 876
Wagman, D. D., 285
Wagner, C. D., 1325
Wagner, C. R., 1289
Wagner, E. C., 1333
Wais, J., Jr., 1388
Waldschmidt, W. A., 16
Walker, H. W., 732
Walker, J. C., 477
Walker, J. M., 1800
Walling, I.W., 237
Walsh, A. D., 617, 1888, 1889
Walsh, D. C., Jr., 876
Walsh, T. J., 266, 1072
Walter, R. B., 810
Walters, E. L., 1202, 1289
Walters, R. F., 20, 1735
Walters, R. P., 38
Walton, P. T., 1733
Wanenmacher, J., 365
Ward, A. F. H., 282
Ward, C. C., 605
Ward, J. C., Jr., 1689
Warner, B. R., 627
Warren, W. C., 24
Warrick, H. R., 1689
Wasson, J. I., 417, 1202
Waterman, H. I., 1203
Waterman, L. C., 1289
Waters, J. F., 1271
Watkins, C. H., 876
Watson, C. W., 121
Watson, E. A., 1223
Watson, F. J., 727
Watson, H. L., 1085
Watson, R., 950
Watts, E. V., 1422
Wazer, Van J. R., 1334
Weatherburn, A. S., 168
Weatherby, B. B., 206
Weaver, D. K., 335
Weaver, P., 971
Webb, G. M., 876, 886, 1202
Webber, W. O., 707, 876

Weber, B. V., 329
Weber, G., 56, 65, 227, 338, 343, 508, 529, 533, 931, 1024, 1033, 1048, 1116, 1547, 1599, 1619, 1804
Weeks, L. G., 1365, 1366
Weelden, Van A., 1790
Weinberger, M. A., 877
Weiner, H., 1307
Weiser, H. B., 876
Weissenberg, K., 749
Welensky, I. H., 417
Welge, H. J., 1616
Welling, C. E., 417
Wells, N. C., 1256
Welty, A. B., Jr., 876
Wendell, C. B., 1290
Wendell, C. B., Jr., 652
Wendler, A. P., 966
Wendtlandt, E. A., 178
Wengerd, S. A., 936
West, L. G., 947
West, R. V. O., 658
West, S. S., 185
West, T. S., 967, 1015
Whaley, T. H., Jr., 417
Whalley, H. K., 742
Wharton, J. B., 72
Wheeler, R. R., 1552
Whincup, S., 876
Whistler, A. M., 269
White, C. C., 1155
White, J. U., 1329
Whitehead, W. L., 1
Whitmore, F. C., 118, 1297
Whitney, G. M., 1727
Whittaker, D., 417
Whittaker, E. J. W., 1109
Wickenden, L., 876
Widess, M. B., 990
Wiebe, Ver W. A., 18
Wiemann, J., 428
Wiggins, J. H., 1059
Wilford, A. T., 901
Wilkinson, W. R., 651
Willcox, O. W., 1448
Williams, C. G., 1214, 1903
Williams, E. G., 1072
Williams, F. J., 994
Williams, I., 121
Williams, J. W., 1689
Williams, M. G., 285
Williams, N., 261, 521, 526, 530, 771, 998, 1020, 1034, 1049, 1244, 1247, 1427, 1549, 1598, 1611, 1645, 1646, 1815
Williams, P. H., 876
Williams, P. S., 706
Williams, R. H., 1202
Williams, V. Z., 1878
Willibrand, F. H., 1550
Willing, C. E., 417
Willingham, C. B., 283, 284, 286, 729, 1074, 1488
Willis, Bailey, 175
Willson, C. O., 1560, 1561
Wilson, G. M., 334, 539, 792, 1249, 1387, 1390, 1765
Wilson, J. A., 417, 1272
Wilson, V. M., 1202
Wilson, W. H., 1796
Wilson, W. Kerr, 152, 312
Wilson, W. W., 368
Wilton, T. O., 1072
Wineman, W. H., 707
Wingrove, B. R., 1289
Winn, W. E., 706
Winning, C., 876, 1289
Winterburn, R., 1405
Wisenbaker, J. D., 527, 803
Wolf, A., 466, 706, 755, 902, 976, 1216, 1709
Wolfrom, M. L., 1302
Wolk, I. L., 876
Wood, G. F., 890
Wood, W. H., 1192
Woodford, A. O., 15
Wood-Mallock, J. C., 1202
Woods, E. H., 86
Woods, W. H., 1817, 1818
Woodward, R. E., 876
Woodward, S. W., 1588
Woolley, W. C., 997
Woolnough, W. G., 327
Work, R. H., 876
Work, R. W., 876
Working, E. B., 1910
Workman, A. R., 1289
Worth, H. J., 751
Wredden, J. H., 145
Wright, D. L., 876
Wright, R. O., 707, 1289
Wrightsman, G. G., 1617
Wrigley, J. B., 814
Wyman, J. B., 876

Yabroff, D. L., 727, 1202
Yanshine, A. L., 956
Yeager, F. W., 876
Youker, M. A., 732
Young, D. W., 876, 1202, 1289
Young, W. S., 1323, 1324
Yuster, S. T., 224, 534, 544, 807, 817, 819, 820, 825, 1047, 1259, 1278, 1425, 1435

Zaba, J., 999, 1159, 1594
Zabel, H. W., 408
Zajac, T. S., 1610
Zaks, S. L., 802
Zanetta, A., 380, 381, 763
Zech, J. D., 417
Zetterholm, E. E., 604
Zimkin, E., 1072
Zimmer, J. C., 876
Zimmerman, G. B., 417, 1289
Zisman, W. A., 899
Zobell, C. E., 6, 1047, 1532, 1720
Zoss, A. O., 756
Zucco, P. S., 1695
Zunino, J. J., 1722
Zwicky, M., 895
Zwilling, J. P., 1204

ABSTRACTS SUBJECT INDEX.

Numbers refer to Abstract Numbers. (P) denotes Abstract of Patent Specification.

Acetone, motor fuel, cold starting, 1901
Acetylene :
  catalytic hydrodimerization, 1067
  from olefin-containing gas (P), 417
  manufacture (P), 876
  recovery from acetylene–diolefin mixture (P), 417
  recovery from hydrocarbons (P), 417
  styrene from (P), 417
Acids, fatty, hydrocarbon formation, 1
Acrylonitrile, manufacture (P), 876
Active carbon :
  activation (P), 417
  heat of wetting determination, 1486
Adsorbent, montmorillonite clay (P), 876
Adsorption :
  measurement on solid–solution interface, 1108
  multimolecular mechanics of, 281
Aerial photography :
  trimetrogon, 767
  use in structure mapping, 766, 936
Agrea Dulce, Texas, 1049
Agriculture, petroleum products in, 1218
Air, accommodation coefficients, 280
Aircraft :
  British, 157
  de-icing, 298
  design, 304
  in Paris show, 155
  power installations, 759, 1121
  Spitfire development, 156, 299
  twin jet A.W.52, 300
Alabama :
  developments in 1945, 79
  Gilbertown oilfield, geology, 1759
  W., pre-Selma stratigraphy, 13
Alaska :
  exploration, 173, 1142, 1560–1
  petroleum possibilities, 30
Albania, production, 835
Aliphatic alcohols, hydrogenolysis, 1298
Aliphatic chlorides, production (P), 876
Aliphatic ether alcohols, barium salts (P), 1289
Alkali-metal oleates, anærobic fermentation, 1690
Alkanes, isomerization, 623, 624
Alkyd resin, manufacture (P), 876, 1689
Alkylates, analyses, 1488
Alkylation :
  benzene (P), 121
  boiling point reduction (P), 727
  *iso*butane, 591, 600, 622
  hydrofluoric acid (P), 727, 876
  hydrogen fluoride recovery (P), 876
  paraffins, 116, (P) 121, 417
  *iso*pentane, 622
  process (P), 417, 876, 1072, 1202, 1689
Alkylation—*cont.*
  sludge, sulphur dioxide from (P), 876
  thiophene, 621
Alkylbenzenes :
  dehydrogenation, 1190
  isomeric, 1301
  thermodynamic properties, 285
Alkyl*cyclo*hexanes, freezing point, 1074
Alkyl*cyclo*pentane, freezing point, 1074
Alkyl*cyclo*propane, preparation, 620
Alkyl disulphides determination, 632
Alkyl halides :
  separation (P), 1689
  sound velocity and absorption, 1704
Alkylparaffin, manufacture (P), 727
Alkyl phenols, metal derivatives (P), 121
Alumina, stabilized (P), 1689
Aluminium dilaurate :
  gels and jellies of, 1313
  in benzene, 1910
Aluminium soaps, water sorption and moisture content, 1899
Amana, Venezuela, 950
Amines, aromatic (P), 1072
Ammonia, from natural gas, 599
Amylenes, manufacture (P), 876
Anderson–Prichard, Oklahoma, 1357
Aniline point determination, aromatics, 649
Anthracene, oxidation rate, 1306
Antioch, Southwest, Oklahoma, 1358
Apollo engine, 1510
Aratu, Brazil, 1053
Area, definition, 1014
Argentina :
  Comodoro Rivadaria–Buenos Aires gas line, 1676
  petroleum industry, 380, 381, 763
  pipeline co-ordination, 1056
  petroleum production, 1172, 1452
  San Pedro oilfield, 32
Arizona :
  developments, 70, 1747
  Grand Canyon geology, 174
  Western, Palæozoic seaways in, 683
Arkansas :
  developments in 1945, 69
  discoveries, 1756
  gas conservation, 65
  Haynesville field, 1619
Aromatic amine stabilization (P), 1289
Asphalt :
  emulsification (P), 876
  rheology, 1092, 1093
Asphalt–concrete flooring, 668
Asphalt macadam, road, 667
Asphaltenes, characteristics, 1086
Atoms, bonded, electronegativities, 127

Australia :
exploration, 695, 1583
natural gas, 712
Queensland, Roma, geology, 1789
stratigraphy, 520
substitute fuels, 480
Austria :
gas discovery, 1152
petroleum production, 574, 835–6, 1461, 1839
Azeotopes, purification (P), 1289
Auricula, boiler oil used in diesels, 1718
Aviation fuel. *See* Gasoline, aviation.

Bacteria, petroleum formation, 54, 222, 821, 1532, 1612, (P) 1047
Bahamas :
exploration, 245
geophysical survey, 1383, 1794
Bahrein, developments, 1284, 1470
Barco concession, Colombia, 1834
Barinas, Venezuela, 513
Barium *tert.*-octyl phenol sulphide (P), 121
Barrier creams, evaluation, 120
Bearings :
dynamically-loaded, performance, 1914
friction reduction, 1503
metals for, 1341, 1504
plain, 143
failure, 665
scoring in, 1502
Beaver oilfield, Kansas, 20
Bell XP-3 engine, 1512
Benzene :
alkylation (P), 121, 876, 1289
aluminium dilaurate in, 1910
ethylation, 110
monoalkylation, 724
purification by azeotropic distillation, 114
sound velocity and absorption, 1704
Benzene derivatives, absorption spectra, 1888–9
Benzene–toluene, analysis, spectrophotometric, 637
Benzoates, manufacture (P), 166
Benzoic acid, from phosgene and benzene, 115
Benzol :
forerunnings :
analysis, 1489
recovery, 1907
refining (P), 417, 1072
wash oil regeneration, 1908
Benzonitrile, from toluene–ammonia, 1688
Benzoyl peroxide, decomposition kinetics, 1867–8
Benzyl chloride, from chloromethylation of benzene, 118
Binary mixtures, analysis, spectrophotometric, 637
Bitumen :
Mexican petroleum, X-ray diffraction, 1209
road, specifications, 1217
manufacture (P), 121, 876
Blankets, dust-laying oil treatment, 168
Block, definition, 1014
Bloomer oilfield, Kansas, 20
Boilers, domestic, economies, 135, 136
Bolivar Coastal oilfield, Venezuela, 35
Bolivia :
developments, 1529
exploration, 1453
petroleum industry, 163
petroleum production, 495, 571, 711, 1658
Bollard method for marine drilling, 330
Bond order, relation to covalent bond distance, 1878
Border oilfield, Montana, 177
Borneo :
oil industry reconstruction, 91
oilfield geology, 40
petroleum production, 1856–7
Boron fluoride, solubility in *n*-pentane, 613
Bradford, Pennsylvania, 816, 823, 831, 921
Brazil :
Bahia, exploration, 382
developments, 1053
petroleum production, 496, 1454, 1465, 1655–7
tectonics, 31
British Borneo, petroleum production, 1682, 1856
British Columbia, Alcan Highway, geology, 1766
Bromobenzene, absorption spectra, 1888
Brookhaven, Mississippi, 1549
Brown Bouveri gas turbine locomotive, 316–7
Burma, developments, 1470
Burner :
atomizer (P), 1289
domestic jet propulsion principle, 1215
fuel oil, 137–140, (P) 1202, 1689
locomotive, 1522
gasoline mantle lamp (P), 1072
kerosine, 1923, (P) 876
rotary, servicing, 455
Butadiene :
azeotropic distillation (P), 1289
from alcohol–acetaldehyde, 1911
from butylene (P), 417
from ethane (P), 417
from ethylene–acetylene (P), 1289
from propene and formaldehyde (P), 1289
monomeric, stabilization (P), 417
polymerization, photochemical, 426
manufacture (P), 876
1 : 2-Butadiene, infra-red spectra, 1694
1 : 3-Butadiene :
equilibrium constants of reactions, 424
infra-red spectra, 1694
Butane, isomerization, 624
*iso*Butane :
alkylation, 116, 600, 622, (P) 417, 876, 1289
alkylation mechanism, 591
2 : 3-dimethylbutane from, 600
from *n*-butane, 412–13

n-Butane :
alkylation, 116
cracking (P), 121
*iso*butane from, 412–3
isomerization, 623, (P) 417, 727, 876, 1202
isomerization with aluminium bromide, 593
Butene :
dehydrogenation (P), 876
interpolymerization, 609
cis-2-Butene :
thermal properties, 730
vibrational frequency, 1075
*iso*Butene :
alkylation, 116
mercury reactions, 1698
thermal properties, 730
vibrational frequency, 1075
trans-2-Butene :
thermal properties, 730
vibrational frequency, 1075
1-Butene :
mercury reactions, 1697
thermal properties, 730
2-Butene :
azeotropic distillation (P), 1289
fractionation (P), 1289
mercury reactions, 1697
Butylbenzene, freezing point, 1074
Butylene, butadiene from (P), 417
*iso*Butylene :
hydrogen chloride addition, 1300
separation (P), 1289
Byoritsu, Formosa, China, 1241

Cables, oil-filled, pressure and oil flow, 1314
Calcite, selective coloration, 1495
Calcium stearate, molecular layers, lubricating properties, 900
California :
developments in 1945, 71
drilling practices, 48
exploration, 242
Kettleman Hills, new oil zone, 1353
Kettleman Hills–Lost Hills, gravity survey, 964
Los Banos sandstones, mineralogy, 14
North Coles Levee field, 226
petroleum geology, 505
pipeline, Kettleman Hills–Los Medanos, 93
Puente and San Jose Hills, Miocene conglomerate, 14
Salt Creek oilfield, 78, 770
Santa Maria :
crude oil treatment, 1021
light oil near, 1544
Ventura Avenue, high pressures in, 1422
well completions, 1728
West Newport, geology, 506
Wilmington oilfield, 769
sand control, 1405

Calorimeter :
flow, for vapours, 1292
for heat of wetting measurement, 1486
melting point, 1316
Cameron engine, 303
Canada :
Alberta :
Brazeau area, 691
developments, 509, 775, 1171
gas reserves, 1765
geophysical survey, 201
Jurassic–Cretaceous boundary, 21
Kinsella gas field, 1765
Leduc oilfield, 1363–4, 1563, 1651, 1762–3
Lloydminster development, 1764
Medicine Hat gas field, 1765
Mildred–Ruth Lakes, bitumen sands, 1362, 1562, 1761
Muskeg anticline, 692
North Pinhorn gas field, 1765
petroleum production, 711, 1833
Viking gas field, 1765
Athabaska bituminous sands, 1237
developments, 87, 1760
exploration, 1050, 1051, 1651
Gaspé, exploration, 1050, 1767
New Brunswick :
petroleum production, 1831
Stony Creek field, 1652
Nova Scotia : exploration, 1050, 1768
petroleum geology progress, 690
petroleum production, 922, 1832
Taber, exploration, 1769
Candeias, Brazil, 1053
Cantagallo, Colombia, 1571
Capillarimeter, precision, 628
Caquot pressure tanks, 853
Carbon :
colloidal, 148
determination, apparatus, 641
thermochemistry, 734
Carbon black :
electron bombardment effect, 1085
furnace process, 1116
halogenation (P), 876
heat of adsorption, 1290
impingement process (P), 121
Micronex, X-ray diffraction, 1209
Carbon dioxide, accommodation coefficients, 280
Carbon monoxide :
accommodation coefficients, 280
detection, 1317
Carbon oxides, reduction products (P), 1072
Carthage, Texas, 1048, 1412, 1551
Castor oil, Bouveault reduction, 1912
Catalysis, process (P), 1689
Catalytic apparatus (P), 1202
Catalysts :
activation (P), 1289
alkoxy aluminium halide (P), 876
alumina–molybdenum oxide (P), 876
aluminium (P), 876
aluminium chloride (P), 876
aluminium–chloride–kerosine (P), 876

Catalysts—*cont.*
aluminium halide (P), 417
aluminium halide–phosphoric acid (P), 417
amination (P), 876
bentonite (P), 121
boron fluoride (P), 417
boron trifluoride, recovery (P), 417
corrosion inhibitor (P), 1289
dehydrogenation activation (P), 417
Friedel–Crafts (P), 876
gel (P), 876, 1689
granular (P), 876
manufacture (P), 121, 1072, 1289, 1689
metal oxide (P), 417
Raney nickel, 629
ring form (P), 876
silica–alumina–zirconia (P), 876
silica gel (P), 1689
spectroscopic tests, 886
Catarole process, 472, 726, 872, 1182
Caustic solutions, gravity and caustic soda content, 481
Cebu, Philippines, 1584
Ceram, oil industry reconstruction, 91
Chicago pneumatic dual fuel engine, 313
Chile, Spring Hill tests, 779, 780, 832, 949, 1141, 1367–71, 1564–8
China :
exploration, 963
Formosa oilfield, 1241
oil resources, 1241
petroleum production, 1853–4
Szechuan field, 1241
Tsungari field, 1241
Yenchang field, 1471
Yuman oilfield, 1241
Chlorination, McIlhiney, ferrocyanide as reducing agent, 1087
Coal :
hydrogenation. *See* Hydrogenation.
pulverized, as fuel, 1908
Coal tar, discontinuous phase, X-ray diffraction, 1209
Coal-tar fuel, 200, 662
Coating composition :
manufacture (P), 876, 1689
paraffin wax–polyvinyl acetate (P), 727
Coevorden, Holland, 90, 252, 781, 954, 1672, 1846–7
Colombia :
Barco concession, 1834
Cantagallo, 1571
El Difícil field, 1571
exploration, 246–8, 510, 777–8, 1145–6, 1148–9, 1372, 1569–71, 1771
Floresanto, 1571
La Salina, 1571, 1770
Llanos region, 693
petroleum industry, 764, 1660
petroleum production, 497, 1455, 1659
tectonics, 31
Tibu field, 1569–70
Velasquez, 1571
Colorado :
Baca Co., Palæozoic rocks, 16
Canon City magnetic survey, 186
Colorado—*cont.*
developments, 77, 1359
Golden, geology, 1731
Gramp's Field oilfield, 15
Rangely :
diamond-bit coring, 526, 793
drilling cost reduction, 1244
geology, 686
structure map, 1140
Colour lakes from lubricating oil stocks, 908
Combustion :
boiler efficiencies, 454
developments in R.N., 930
flame propagation, 151
fuel oil, 135–6
gases :
in tubes, 151
under water (P), 680
spray particle size, 1083
Communications, oilfield, 791
Compressor, free-piston, 915
Convair XP-81 engine, 1512
Corrosion :
boilers, 583
by natural graphite, 898
casing, 56
causes and prevention, 167
drill pipe plastic coatings, 704
drilling equipment :
protection by plastics, 1389, 1475
protection by sodium chromate, 343
inhibitors :
for brine, 541
formaldehyde, 703
Kontol, 115, 260, 347
manufacture (P), 718
sodium chromate, 57, 343, 533
pipeline, 1683
protection, 98, 257–8
plastic coatings, 529, 704, 1389, 1475–6
production equipment, 346, 809–10, 1163, 1438, 1609–10
protection, 56–7, 260, 346–7, 1408, 1816
protective composition (P), 417, 876, 1202, 1289
refinery plant, 386
protection, 1475–6
springs, protection, 1525
storage tanks, protection, 1058, 1472
Cotswold air-screw turbine, 1219
Cracking :
catalysts :
bead, coke combustion, 869
Filtrol (P), 876
manufacture (P), 121, 1202
metal oxide–silica gel (P), 876
regeneration (P), 876
silica–alumina, analysis, 1318
catalytic process (P), 876, 1072, 1202, 1289, 1689
catalytic, suspensoid, 1866
coking unit at Toledo refinery, 107
fluid catalytic :
catalyst regeneration, 868

Cracking—*cont.*
fluid catalytic—*cont.*
naphthas from, 722
technique, 401
U.O.P., 723
Leonard T.C.C. Unit, 1481
natural gas–steam reaction, 590
polyform process, 587–9
process (P), 121, 417, 727, 876, 1289
residual feed stocks, 1066
T.C.C., catalyst replacement, 405
thermal, yield factors, 1186
Thermofor, temperature effect, 1187
Cracking plant:
catalytic:
Houdry reactor, 403
modern, 270
pilot plant at Sunbury, 866
delayed coking unit, 271, 867
fluid catalytic:
automatic control, 400
gas–solid separator (P), 121
small scale, 108
largest, 406
operation (P), 876
T.C.C., 404
commercial, 109
thermal, conversion to T.C.C., 1686
Creole oilfield, Gulf Coast, 1758
Creosote pitch mixture, 662
o-Cresol, high-pressure hydrogenation, 1296
Crude oils:
British, 1213
dehydration plant, 1862
demulsification, 350, 351, (P) 707
deodorization (P), 121
desalting, 351, 391, 580, (P) 417, 876
fluorochemical analysis, 978
gum deposition in treatment, 397
treatment economics, 353
Cuba:
Camagüey, palæontology, 516
petroleum production, 1654
Cunningham oilfield, Kansas, 556
Curve greases, 469
Cut Bank oilfield, Montana, 177
Cutting oil:
manufacture (P), 876, 1289, 1689
sulpho-chlorinated, 904
Cymene, manufacture (P), 121
β-Cymene, from terpene (P), 121
Czechoslovakia:
developments, 1841–2
natural gas search, 838
petroleum production, 835

D.D.T. *See* Insecticides.
Dakota, South, geology, 687
De Havilland Ghost engine, 674, 1511
Decanes, physical properties, 1291
Dehydrogenation:
catalytic (P), 1072
hydrocarbon (P), 121
Delaware, West Texas, 1552
Delaware–Childers, Oklahoma, 1406
Delhi, Louisiana, 1448, 1547
Denmark, exploration, 1776–7
Desulphurization:
Linde process, 871
process (P), 876, 727, 1689
Detergents:
manufacture (P), 417, 876
refractive indexes, 1700
solubilization of organic liquids, 146
Detonation:
anti-detonants:
lead tetraethyl, 450, 451
manufacture (P), 876, 1202
organic nitrogen, 290, 451
tetraethyl lead, 290
electronic meter, 288, 646
Ethyl Corpn. research laboratory, 325
fuel chemical structure, 452
intensity determination (P), 417
measurement, multicylinder engine (P), 1202
octane number determination, 437
prevention (P), 417
Dialkylacetylenes, determination, 1325
Dialkylbenzene, dehydrogenation, 1191
Dialkyl naphthenes, geometric configuration, 1883
Dichlorobenzene, absorption spectra, 1887
Dielectrics, rheological properties, 897
Diesel fuel:
boiler oil as, 747
cetane number:
relation to gravity and b.p. index, 453
significance, 456
heavy, 895
lubricant additive (P), 1689
manufacture (P), 1072
prices, 322, 919
sources, 675
supply and demand, 1500
Diethyl ether, motor fuel, cold starting, 1901
Diethylbenzene, physical properties, 612
Dihaloalkanes, manufacture (P), 876
Di*iso*butane, boron–trifluoride reaction (P), 877
Di*iso*propyl, manufacture (P), 876, 1202
2 : 2-Dimethylbutane-2 : 3-dimethylbutane, liquid–solid equilibrium, 1309
2 : 3-Dimethylbutane, from *iso*butane, 600
2 : 2-Dimethylbutane-*cyclo*pentane, liquid–solid equilibrium, 1309
2 : 3-Dimethylbutenes, manufacture (P), 876
1 : 1-Dimethyl*cyclo*hexane, infra-red absorption, 1076
cis-1 : 2-Dimethyl*cyclo*hexane, infra-red absorption, 1076
trans-1 : 2-Dimethyl*cyclo*hexane, infra-red absorption, 1076
1 : 1-Dimethyl*cyclo*pentane, infra-red absorption, 1076
cis-1 : 2-Dimethyl*cyclo*pentane, infra-red absorption, 1076
trans-1 : 2-Dimethyl*cyclo*pentane, infra-red absorption, 1076

trans-1 : 3-Dimethyl*cyclo*pentane, infrared absorption, 1076
1 : 2-Dimethyl-3-ethyl*cyclo*propane, preparation, 620
2 : 4-Dimethylpentane, manufacture (P), 727
Dimethylsiloxane polymers, viscosities, 503
2 : 3 : 1′ : 8′-Dinaphthalene, 276
Dispersions, water-in-oil (P), 876
  acid-treated oil corrosion prevention (P), 876
Distillation :
  azeotropic (P), 876, 1689
  crude oil, gummy deposits, 397
  extractive, furfural–water analysis, 658
  flow controller, proportional, 651
  fractionating columns :
    continuous, 1184
    design, 266, (P) 876
    plate calculations, 387, 595
  pipe-still outlet temperature, 584
  laboratory :
    apparatus evaluation, 653
    column head (P), 1072
    falling-film still, 739
    fractionation column, 445, 655, 1332
    product withdrawal, 654
    vapour–liquid equilibrium still, 635
  multi-component mixtures, 105
  pipe still design, 265
  process (P), 876, 1072
  superfraction, 605
  ternary mixtures, 104
  twenty centuries of, 1185
District, definition, 1014
Drilling :
  blowout control, 702
  cable-tool, 1805
  California practices, 48
  casing, stuck, location of, 1387
  cementing, 216
    casing rotation, 1011
    squeeze, 1801
  coring, diamond-bit, 526
  costs, 44, 211–2, 1244
  deep, 1598
  deepest well, 998, 1634, 1646, 1650
  diamond, 49
  directional, 335, 789, 794–5, 1007–8, 1597
  efficiency and cost, 88
  Electrodrill method, 1591
  engineering in, 219
  gas control, 530
  high-pressure, mud weight recording, 531
  horizontal drain holes, 1004
  kicking, combating, 1595
  lateral, 522
  logging, 1155, 1394, 1423, 1808
    ionizing radiation detection, 1873
    neutron, 1395
    thermal, 1396
  marine, 213, 333, 1000, 1002, 1601
    bollard method, 46, 330
  mud removal, 797
  reverse circulation, 51
Drilling—*cont.*
  rock, 1001
  rotary, 999, 1159, 1594, 1806
    speed and rock hardness, 45
  speed, increase by larger drill pipe, 1010
  testing strata, core freezing, 527
  thief formation combating, 1595
  well testing, 1384
  without pilot hole, 332
Drilling equipment :
  boiler, hydrostatic (P), 1013
  barges, 524, 525, 1246, 1385, 1596
    boiler, 1003
    cementing, 1247
    diesel-electric, 525, 787
  bit :
    elongated (P), 706
    reconditioning, 1386
    rotary (P), 706
  boiler feed (P), 706
  brake mechanism (P), 706
    air-operated, 1005
  casing, 1245
    design, 1388
    moving of, 1249
    sanding practice, 215
    stress effect, 1814
    warm worked, 337
  casing perforator (P), 52
  casing support (P), 706
  cement, hydraulic (P), 706
  cementing unit, 1407, (P) 1013
  chain design, 701
  clamp (P), 1013
  cooling, separate, 1807
  core barrel (P), 1013
  coring, 334, 793, 1391, (P) 1013
  corrosion protection :
    formaldehyde, 703
    plastic, 529, 1475
    sodium chromate, 343, 533
  costs, 1600
  derrick base (P), 1013
  derricks, muffled, 1390
  developments, 42, 43
  diesel-electric auxiliaries, 1802
  drill collar (P), 706
  drill holder (P), 1605
  drill pipe :
    corrosion protection by plastics, 704, 1389
    cutting, 1393
    failure by fatigue, 339
    fishing, 1393
    moving of, 1249
    testing, 338
    tool to keep free, 342
    torque strength, 1251
    yield strength, 214
  drill pipe rack (P), 1013
  drill-pipe tester, 1250
  drive, torque converter, 1248, 1392
  engines :
    diesel, 488
    maintenance, 336
    selection, 340
  fishing tool (P), 1013

Drilling equipment—*cont.*
graph machine (P), 52
gun perforator, 528
hard formation, 47
hydraulic drives, 796
inclinometer (P), 1013
logging, electrical (P), 706, 1013
Magna–Tector, 1387
marine, 46, 1006, 1802
masts (P), 1202
modern, 1593
mud pumps :
mud compressibility effect, 341
piston lubrication, 1604
mud screen (P), 706
mud weight recorder, 531
permeability tester (P), 1013
pipe-screwing device (P), 1013
pressure recorder (P), 706
pump, free, 1811
record keeping, 1803
rig, 786
air-operated, 700
Britain's largest, 210
heavy, 1599
marine, 788 790
moving, 1804
portable, 521, 523, (P) 706
unitized, 331
rotary :
design (P), 706
developments, 42
rotary swivel (P), 1013
setting and releasing tool (P), 706
shooting plug, 1009
slips (P), 706
slush pump, 50
slush tube (P), 706
tubing, torque strength, 1251
water locator (P), 706
water loss reduction (P), 1013
well radioactivity measurement (P), 706
wire ropes, 1245
maintenance, 1252
Drilling mud :
barite recovery, 532
carboxymethylcellulose in, 217
clay chemistry, 1160
filtration control, 1397
hydrocarbon detection, 744
manufacture (P), 1072
oil-base, 218, 1399
selection, 1400, 1810
starch in, 1603
testing, 1809
treatment, 705, 1398
yield value determination, 442
Drying oils :
from wool wax acids, 1913
gelling of, 1508
manufacture (P), 1289
Dukhan, Qatar, 1284
Dust-laying oil :
application to fabrics, 168
manufacture (P), 121

East Guara, Venezuela, 515
East Indies :
developments, 1856–7
oil industry restoration, 91, 714
oilfield geology, 40
petroleum geology, 1682
reef coral evolution, 39
Ecuador :
exploration, 511
oil operations, 1661
petroleum production, 572
tectonics, 31
Upper Cretaceous and Paleocene micropalæontology, 33
Egypt :
developments, 1470
exploration, 518, 782, 1284, 1376–7, 1576
petroleum production, 848
El Dificil, Colombia, 1571
Electrodrill drilling method, 1591–2
Electron scattering by hydrocarbon films, 126
Emersol process, 725
Emulsifiers :
industrial, 874, 1229
manufacture (P), 1072
Emulsion :
bituminous :
adhesivity increase (P), 1289
manufacture (P), 876
demulsification, 350, 351, 799, (P) 417, 727
industrial, 467, 468
oil-in-water, chemical resolution, 804
testing, 740
Engines :
aircraft, 759, 301–2, 305–6
Apollo, 1510
British, 159, 161, 1711–2
Cameron, 303, 484
cold starting, 485
Cotswold turbine, 1219
De Havilland Ghost, 674, 1511
ejector performance, 297
fuel systems, 296
Goblin, 1509
in Paris show, 160
Pratt and Whitney Wasp, 1340
Rolls-Royce Eagle, 911
Rolls-Royce Nene, 760
selection, 1121
supercharged, operation (P), 1689
Theseus, 912
Thornton research laboratory, 1228
U.S.S.R., 486
bearing metals, 1341
bearing, research, 1227
C.A.V.–Ricardo pintaux nozzle, 1917
Chicago pneumatic duel fuel, 313
compression-ignition :
fuels and lubricants, 675
Harland and Wolff, 1918
low-temperature starting, 914
Ruston high-power, 1919
Waukesha–Hesselman, 916
cylinder bore wear, 913
cylinder liner, 1524

Engines—*cont.*
cylinder temperature measurement, 1220
cylinders, chromium-treated, 1119
diesel :
cold starting, 308, 310
combustion in, 309
exhaust-smoke measurement, 490
fuel consumption, 134
German, 311
heavy oils for, 875
opposed piston, 312
Polar, 761
supercharged, 307
testing, 1519
Thornycroft marine, 1520
use in oil industry, 488
Ethyl Corpn. research laboratory, 325
exhaust, smoke cause, 1517
exhaust gases, analysis, 1497
Fedden, 154
filters, oil, 1113
fouling by lubricants, 1114
free-piston, 314, 915
fuel consumption and power output, 743, 884
gas turbine, 1224
American, 1512
British, 315
"can" combustion chamber, 1223
ceramics in, 150
efficiencies, 1715, 1922
for bunker C fuel, 491
fuels and lubricants, 1214, 1903
G.E.C., 1714
generator, 917–18
locomotive, 316–17
marine, 1225, 1920
Napier Naiad, 1713
performance calculation, 1122
Metrovick, 1222
thermodynamics, 1523
Hercules 2000 h.p., 153
high-compression, 1498
internal combustion :
breaking-in (P), 1072
cold starting, 489, 914
silencing, 1120
water injection, 487
water temperature, 1516
internal combustion-gas turbine, 1226
Leonides, 158
loop-scavange, 1514
manifold, gas vibration analysis, 1916
marine :
opposed piston, 152
Ruston, 1521
oil consumption reduction, 753
Petter–Fielding, 1221
piston assembly (P), 1689
Polar two-stroke, 1515
research, photographic, 1513, 1717
rocket, 1716
turbo-jet, thermal analysis, 1123
wear, filter effect, 1915
wear reduction, chemical treatment, 752
Esteramides, sub-resinous (P), 1289
Esters, reduction by sodium, 607
Ethane :
butadiene from (P), 417
dehydrogenation, 1190
Ethene, decomposition, 1203
Ethyl alcohol :
dehydration (P), 1689
motor fuel, cold starting, 1901
Ethylbenzene :
from ethyl*cyclo*hexane (P), 417
manufacture, 601, (P) 1202
solubilization, 1702
styrene from, 597, 604, (P) 1202
vibrational frequencies, 1081
Ethyl*cyclo*pentane, vapour pressure and density, 1311
Ethylene :
alkylation (P), 876
oxidation, 421–3, (P) 727
propylene from (P), 417
polymerization (P), 417, 1072, 1202, 1689
thermal properties, 730
vibrational frequency, 1075
viscosity measurement, 1487
Ethylene oxide, structure, 617, 878, 1078, 1691–2
3-Ethyl-5-methylpyridine, 1303
Europe :
Carpathian oilfields, 38
Central, oil economics, 1151
petroleum imports, 1234
petroleum production, 835

Fatty acids. *See* Acids, fatty.
Fault block, definition, 1014
Field, definition, 1014
Film thickness, radiographic measurement, 1494
Filtration :
colloidal graphite, 463
pre-coat (P), 417
Filtrol catalyst (P), 876
Fires, extinguishing, 728, 1199–1201
Fischer–Tropsch process :
catalyst :
activity, 736, 737
analysis, 657
cobalt–thoria–magnesium, 1870
developments, 409, 602
German developments, 1871
improvements (P), 876
Japanese developments, 1344
methane participation, 736, 1195
synthesis gas production, 289
with ketene, 627
Flame-thrower fuels :
gelled petrol, 483
Napalm thickener, 670
Floresanto, Colombia, 1571
Florida :
geology, 940
developments in 1945, 79
north, geology, 176
Sunniland oilfield, 176

Flow :
inhomogeneous, behaviour of macromolecules, 278
plastic, 428–30
Fluid flow :
chart for pressures, 97
flowmeters :
calorimetric, 1876
pulsation errors, 415
forced oscillations in tubes, 1518
gas through ideal porous media, 1425
gas-condensate reservoirs, 1162, 1163
in rough tubes, turbulent, 1205
in sands, temperature effect, 802
in tubes, 883
in water and oil strata, 183
maximum flow determination, 119
percolation through porous media, 1253
Fluid solids, utilization (P), 1289
Fluids, solid and gaseous, contacting (P), 1202
Flushing oil (P), 1202
Foam inhibited oil (P), 417, 876
Fog :
artificial (P), 1202
dispersal, 502
Formation, definition, 1014
Formosa, China, 1241
Fractionating column. *See* Distillation.
France :
Aquitane basin, 37
developments, 1778
exploration, 839, 840, 1240
gas exploitation, 1844–5
Gensac oilfield, 953
locomotive conversions to oil, 765
natural gas, production, 1240
Pechelbronn, developments, 1843
petroleum production, 835
refinery restoration, 1531
storage repair, 853
substitute fuels, 499–500
Friction, abrasion and, 1109
Fruit, waxing (P), 876
Fuel oil :
burning, 137–40
burning index, 894
carbon–hydrogen ratio, 1499
combustion, 135–6
creosote–pitch mixture, 662
for high temperature processes, 661
manufacture (P), 1689
prices, 322, 919, 1719
properties, 660
refinery, 896
utilization in Great Britain, 1343
Fuels :
gas turbine, vaporization, 420
gaseous, combustion under water (P), 680
prices, 1719
Furnace :
domestic, jet propulsion principle, 1215
fuel oil, efficiency, 135, 136

G.E.C. gas turbine, 1714
Ganzo Azul, Peru, 1573
Gas oil :
bubble points, 420
dew points, 420
Gas turbine fuels, vaporization, 892
Gas turbines. *See* Engines.
Gases :
accommodation coefficients, 128
adsorption apparatus, 652
analyser (P), 1202
catalytic reactions (P), 876
combustion in tubes, 151
cracked, hydrogen sulphide removal, 402
dangerous, detector (P), 1289
farm manure, 1230
fuel, under-water combustion (P), 680
high-temperature, recovery of particles (P), 417
hydrate forming component removal (P), 1202
hydrogen sulphide, determination, 647
pumping, pulsation dampening (P), 727
refinery, oxygenated chemicals, 478
separation (P), 1689
solids separation (P), 121
sulphur determination, 648
sulphur dioxide separation (P), 727
temperature, pseudo-critical, 1819
Gasoline :
aromatics determination, 644, 1320
aromatics extraction (P), 1289
aviation :
alkylate-hydropolymer content, 274
containing hydrindene (P), 121
manufacture (P), 121 417, 727, 876, 1202, 1289, 1689
bubble points, 420
catalytic reforming (P), 1202
copper strip corrosion tests, 1705
cracked, bromine number reduction (P), 121
desulphurization, catalytic, 275, 1192
dew points, 420
dispensing system (P), 417
gelation, 483
Napalm thickener, 670
gum inhibitor (P), 1289
hydroforming process, 410, (P) 1289
hydrogen disproportion, 1287, 1480
inhibitor (P), 417
iron pentacarbonyl determination, 1490
isomerization, 598
knock-rating, *n*-heptane reference fuel, 132
leaded, tributyl phosphite addition (P), 876
manufacture (P), 121, 727, 1072
molecular weight correlation, 123
naphthenes determination, 1320, 1321
octane number and peroxide content, 448
octane rating trends in U.S.A., 1100
olefins determination, 645
olefins removal (P), 417
paraffins determination, 1321

Gasoline—*cont.*
polyforming, 273
spectroscopic study, 438
stabilization (P), 1072
sulphur compounds, 449
sulphur determination, 643
synthesis (P), 1689
Synthol process, 1484
tests, laboratory *v.* performance, 888
tetraethyl lead, microdetermination, 1319
toluene from (P), 1202
United States, quality and supply, 1131
viscosity, 106
100-octane, vaporization, 892
See also Motor fuel.
Gaspé, Canada, 1767
Gaza, Palestine, 1378
Gear-boxes, pre-selective, lubrication, 901
Gears, hypoid, 470
Geletrol, 483
Gelled oils (P), 876
Gensac, France, 953
Geochemical prospecting :
developments, 184
disturbing factors, 981
method (P), 41
Geochemistry, processes in Permian deposits, 1243
Geologists, services in wartime, 9
Geology. *See* Petroleum geology.
Geophysical surveying :
amplifier, resistance-coupled, 202
case history publication, 11
data use improvement, 328
developments, 1790, 1792
electrical, 975
field of oscillating dipole, 976
electromagnetic waves in, 977
fluorescent surveys, 200
geophone (P), 698
gravimetric, 201, 1380
airborne, 1382
ambiguity in, 979
anomaly solution, 972
submarine : 784, 980
tripod for, 1588
zerodrift error, 995
logging :
electric, 1155
radioactive, 1800
magnetic, 1586
over igneous pipes, 186
magnetometer, airborne, 197–9, 697, 982, 1381, 1383, 1795
marine, radar in, 1796
micromagnetic, structural correlation, 1156
oblique reflection, data analysis, 187
organization, 208, 970
precision radar, 203
principles for determining surface conditions, 1791
radioactivity, interpretation and application, 1157
radiographic, 1797
Geophysical surveying—*cont.*
reflection shooting, well velocity data, 992, 993
refraction, developments, 965
refraction shooting, continuous profiling, 983
Resistoloy method, 967
seismic :
airplane noise interference, 985
correlation refraction, 984
cross-section plotting, 195
data review and analysis, 192
depth-displacement slide rule, 973
detonation velocity, 974
distortion testing, 188
elastic waves, 988
explosive hazards, 989
path curvature effect, 190
plane waves, 986
portable equipment, 1589
Raleigh waves, 987
refraction technique, 1158, 1798
refractive wave reflection, 191
repeated *P*-waves, 189
salt column depth, 991
shot point procedure, 994
structural correlation, 1156
surface topography effect, 990
velocity-depth relationship, 196
seismometer (P), 698, 996
selection, 971
soil–air ion measurement, 193
techniques, 1585
torsion balance, 204
inundated areas, 1799
trends in, 209
U.S.A., 1587
world activity, 205
Georgia :
developments in 1945, 79
exploration, 938
Germany :
fuel technology reports, 1339
hydrogenation plants, 117
lubricants, storage and distribution, 666
lubricating oil technology, 292
oilfield developments, 89
petroleum industry, 162
petroleum production, 835, 1173, 1673–4
Reitbrook oilfield, 1779
rockets, 1236
synthesis developments, 870, 1871
technical reports, 673, 910
Ghost engine, 674, 1511
Gilbertown oilfield, Alabama, 1759
Glycerides, Bouveault reduction, 1912
Goblin engine, 1509
Gold Coast, exploration, 1785
Gramps Field, Colorado, 16
Graphite :
corrosion by, 898
n-heptane absorption film, 122
Great Britain :
Catarole plant, 472, 726, 872, 1182
crude oil, 1213

Great Britain—*cont.*
exploration, 251, 519, 837, 1774–5, 1840
fuel oil developments, 1343
geosynclines, 952
largest drilling rig, 210
oil equipment industry, 929
oilfield geology, 36
Petrochemicals Ltd. plant, 1182
petroleum Acts, chemical aspects, 1893
petroleum chemical plants, 872, 873, 905, 1069
petroleum production, 835
petroleum trade, 324, 676–7, 923–8, 1129, 1233, 1342, 1927–8
storage, wartime, 854
Group, definition, 1014
Guario oilfield, Venezuela, 1838
Guatemala, oil possibilities, 512
Guico oilfield, Venezuela, 1838

Haiti, exploration, 1578
Harris Co., Texas, 27
Hawkins oilfield, Texas, 178
Haynesville field, Louisiana–Arkansas, 1619
Heat exchange :
coefficients for vapour condensation, 596
control (P), 1689
fluid and porous solid, 1295
low temperature, 1864
Helium :
accommodation coefficients, 280
pipeline transport, 100
*cyclo*Heptane, heat of combustion, 1293
n-Heptane :
absorption film on graphite, 122
heat capacities, 1292
Hexachloro*cyclo*hexane, insecticide, 482
Hexane :
isomerization (P), 121
isomers :
critical constants, 625
thermal data, 610
*cyclo*Hexane :
heat capacity, 619
heat of combustion, 1293
infra-red absorption, 1076, 1696
manufacture (P), 876
*cyclo*Hexane carboxylic acid radioactivity effect, 626
n-Hexane, film coefficients, 434
1-Hexane, isomerization, 111
*cyclo*Hexyleicosanes, preparation, 1297
*cyclo*Hexylidane, 1485
Holland :
Coevorden oilfield, 90, 252, 781, 954, 1672, 1846–7
petroleum production, 252, 835
refineries in, 1183
Houdry catalytic cracking reactor, 403
Howard, Oklahoma, 1550
Hub-web greases, 469
Huleiquat, Palestine, 1378
Hungary :
developments, 1462
exploration, 1153, 1579
Hungary—*cont.*
oilfield geology, 38
petroleum production, 835, 1462, 1465, 1848
Hydraulic oil (P), 876, 1202
Hydrocarbons :
aliphatic, synthesis, 592
aliphatic-cyclic, dehydrogenation, 1190
alkylates, analyses, 1488
analysis :
by relative light dispersion, 444
spectroscopic, 443, 637, 639, 642, 1328–30
aromatic :
alkylation (P), 417, 727, 876, 1202, 1689
Antoine vapour-pressure equation, 1082
Catarole process, 472, 726, 872, 1182
*cyclo*pentylation, 1068
determination in gasoline, 644
extraction (P), 417
from petroleum, 1869
high-pressure hydrogenation, 1296
isomerization (P), 727
manufacture (P), 121, 727, 876
molecular volumes, 124
nitration (P), 876
oxidation rate, 1306
butadiene extraction (P), 1202
carcinogenic activity, 1306
catalytic treatment (P), 876
catalytically active material removal (P), 1289
condensation products (P), 876
conversion (P), 876, 1202, 1689
C_2–C_7, separation (P), 876
C_4, extractive distillation (P), 417
C_5 diolefines, separation (P), 1202
C_nD_{2n+2}, infra-red spectrum, 1208
dehydrogenation (P), 876
diene, polymerization, 732
diolefin :
aliphatic conjugated (P), 121
concentration (P), 1289
conjugated, determination, 638
dimerization (P), 1289
from pentenes, 615
manufacture (P), 417, 876, 1072, 1202, 1289
electrolytic solutions in, 279
entropy, 735
fluorine removal (P), 1289
halogenated (P), 1202
heats of formation, 735
high molecular weight air oxidation, 408
hydrocodimers, analyses, 1488
hydrogen fluoride removal (P), 1289
hydrogen sulphide removal (P), 1202
low-boiling :
physical constants, 427
synthesis, 630
mass spectra, temperature effect, 1701
mono-olefin :
diolefins from (P), 417
manufacture (P), 1689
polymerization (P), 417, 876

Hydrocarbons—*cont.*
naphthene :
alkylation (P), 417
dehydrogenation (P), 876, 1289
heat capacity, 619
oxidation (P), 1202
non-benzenoid, conversion (P), 876
notation, 1884
olefin :
alkylation (P), 1289
autoxidation, 1188
catalyst activation (P), 417
conversion (P), 876
dehydrogenation (P), 1289
determination in gasoline, 645
formaldehyde reaction (P), 1689
gaseous, determination, 1327
hydration (P), 1072
isomerization (P), 876
manufacture (P), 1289
oxidation, 1886
polymerization (P), 121, 727, 876, 1072, 1118, 1689
structure and peroxidation, 733
unsaturated alcohols from, 1188
vibrational frequencies, 1075
*cyclo*olefinic (P), 876
tert.-olefins, separation (P), 1689
paraffin :
alkylation, 116, (P) 1289
branched chain (P), 1689
from synthetic gasoline, 721
isomerization (P), 121, 417, 1072, 1202
" long chain frequency," 1208
manufacture (P), 727, 876
solubility, 1699
unsaturateds separation (P), 1202
*cyclo*paraffin, hydroaromatic (P), 1689
*iso*paraffin :
alkylation (P), 121, 417, 876
liquid (P), 121
manufacture (P), 121, 727
n-paraffin, isomerization (P), 1689
paraffin/oxygen, oxidation reaction, 418
polycyclic aromatic, alkylation to synthetic lubricants, 1102
pure :
maintenance of standards, 879
specific dispersion calculation, 631
standard samples, 729
viscosities, 608
purification, 1074
research by U.O.P. Co., 616
smoke tendency, 125, 431
solubilization, 1702
standard :
freezing point and purity, 286
purification and sealing, 284
thermodynamic properties, 432, 433, 755, 880
See also individual hydrocarbons.
Hydrocodimers, analyses, 283, 1488
Hydrocol process for petroleum chemicals, 1906
Hydrofluoric acid, for desalting crude (P), 417
Hydroforming, 410
Hydrogen :
accommodation coefficients, 280
detection in submarines (P), 1289
determination, apparatus, 641
manufacture, 603, (P) 1072
sorption on alumina, 1310
Hydrogen halide, distillation (P), 1689
Hydrogenation :
catalyst, for sulphurous oils (P), 876
coal, Germany, 117, 1871
process (P), 417, 1072, 1289
Hypercal laboratory fractionation column, 398
Hypersorption process, 1338
Hypoid gears, 470

Illinois :
developments, 1737
McClosky oilfield, 235
Mattoon oilfield, 771
Patoka oilfield, 235
Siggins oilfield, 235
Incendiaries, smoke tendency, 125
Indane, alkylation, 1485
India :
developments, 850, 1786
petroleum production, 1470
Indiana :
developments, 1737
petroleum production, 1546
Insecticides :
aerosols :
for mosquitoes and houseflies, 474
heat-generated, 473
D.D.T. :
determination in dusts and oils, 650
preparation, 672
synthesis, 1507
1 : 1-Dihalopropene (P), 1289
hexachloro*cyclo*hexane, 482
manufacture (P), 1689
*iso*paraffinic (P), 876
petroleum, 1218
Insulating oil :
cable, spreading measurement, 131
manufacture (P), 1202
Interfacial tension, measurement, centrifugal method, 1094
Interval, definition, 1014
Iodobenzene, absorption spectra, 1888
Iran :
developments, 1470
oil prospects, 181
oilfield geology, 181
petroleum production, 253, 575–6, 849, 1176, 1285, 1466–9, 1677–80
petroleum reserves, 1575
wartime labour, 1065
Iraq :
developments, 1470
pipeline, 715
Iron pentacarbonyl determination, 1490
Isomate isomerization process, 111, 411
Isomerization :
aliphatic hydrocarbon synthesis, 592
n-butane by aluminium bromide, 593

Isomerization—*cont.*
butane plant conversion to polymerization plant, 586
C_4 fraction (P), 121
gasoline, olefinic, 598
hexane, 111, (P) 121
Isomate process, 111, 411
paraffins (P), 121, 417
pentane, 112, (P) 121
pretreatment (P), 121
Shell vapour-phase process, 412–3
U.O.P. unit, conversion to polymerization, 1189, 1482
water removal (P), 876
Isoprene :
from propylene (P), 417
from trimethylethylene (P), 417
infra-red spectra, 1694
manufacture (P), 876
Italy :
exploration, 841, 1465
oil research, 321
petroleum industry, 501, 1130
road bitumen specifications, 1217
Itaparico, Brazil, 1053

Jackson, Texas, 1360
Japan :
oilfields, 1242
petroleum production, 851, 1681, 1787, 1855
petroleum reserves, 852
rockets, 1236
synthetic oil, 1344
Teshio discovery, 1783
Jarahueca, Cuba, 1654
Java :
isostatic anomalies south of, 969
oil industry reconstruction, 91
oilfield geology, 40
Jet engines. *See* Engines : gas turbines.
Jet propulsion, energy evolution, 882
Jutland, exploration, 1580

Kansas :
Beaver oilfield, 20
Bloomer oilfield, 20
central :
geology, 1734
Ordovician limestones, 1354
crude oil-stratigraphy relationship, 507
Cunningham oilfield repressuring, 556
developments, 74, 1736
Kraft–Prusa oilfield, 20
pre-Cambrian hills, 20
Sedgwick Co., Kinderhook dolomite, 18
Silica Arbuckle field recovery-well spacing relation, 369
Siluro–Devonian strata, 19
Katy field, Texas, 26
Kentucky, developments, 75, 1744
Kerosine :
bubble points, 420
dew points, 420
inhibitor (P), 417
molecular weight correlation, 123
vaporization, 892
Ketones :
aliphatic (P), 1072
oxidation (P), 876
unsaturated (P), 1289
Kettleman Hills, California, 1353
Kevin oilfield, Montana, 177
Kinsella gas field, Alberta, 1765
Knock-rating, aviation fuel, oxygen boost method, 1315
Kontol 115 corrosion inhibitor, 260, 347
Koppers gasification process, 1194
Kraft–Prusa oilfield, Kansas, 20
Kurnub, Palestine, 1378
Kuwait :
developments, 1284, 1926
petroleum production, 1852

La Gloria, Texas, 997, 1049
La Salina, Colombia, 1571, 1770
Langlie Unitized repressuring project, 367
Laochionmiao, China, 1241
Latent heat, power laws of, 1206
Lead alkyl compounds (P), 876
Lead tetraethyl, anti-detonant, 450, 451
Leduc, Canada, 1363–4, 1563, 1651, 1762–3
Lignite, gasification, Koppers process, 1194
Linde copper sweetening process, 871
Lindsay, Oklahoma, 1356
Linoleates, manufacture (P), 166
Linseed oil, Bouveault reduction, 1912
Liquefied petroleum gas :
applications, 762
developments, 447
dispensing system (P), 121
supply and demand, 1231
uses and trends, 1097
Liquid delivery, apparatus, 1322
Liquid volume, temperature conversion, 1477
Lloydminster, Alberta, 1764
Lobata, Brazil, 1053
Locomotives :
French, conversion to oil, 765
fuel oil burner, 1522
gas turbine, economics, 1921
Loma Alto–Seven Sisters, Texas, 967
Los Banos, California, 14
Los Cerritos, Venezuela, 514
Louisiana :
Delhi oilfield, 1448, 1547
developments in 1945, 69, 72
Erath, salt water disposal system, 64
Gulf Coast, developments, 1757
Haynesville oilfield, 1619
north, discoveries, 1756
submarine exploration, 783
Lovell Lake, Texas, 966
Lubricants :
additives, 1110, 1114
graphite, filtration, 463
manufacture (P), 121, 417, 876, 1202, 1289, 1689
air bubble rise in, 1101
antifriction (P), 1289

Lubricants—*cont.*
Clock (P), 876
corrosion inhibitor (P), 1289
crankcase, ageing tests, 130, 440, 441
desulphurization (P), 727
deterioration cause, 461
distillation, vacuum, 113
electrical properties, 459
engine, compression-ignition, 675
films, fluidity measurement, 1112
foam suppression, silicone compounds, 1687
gas turbine, 1214, 1903
German developments, 292
graphited, running-in, 1336
instrument (P), 876
heavy duty, engine testing, 291
manufacture (P), 417, 727, 1072, 1202, 1289, 1478, 1689
molecular weight correlations, 123
motor, filtration, 1113
oleophobic films, 899, 1312
optical properties, 459
oxidation: 1110
inhibitor (P), 417
physical properties: 663
and chemical constitution, 457
pour-point depressants (P), 1289
reclaiming (P), 1689
sludge removal (P), 1689
solvent extraction, 748
furfural, 1479
stage estimation, 1491
synthetic, 1102, (P) 417
testing, 750
engine, 1706
four-ball machine, 435
laboratory *v.* performance, 888
thin films, detection by radiography, 1494
used, filters, 141
viscosity, 1106, 1110, 1710
dependence on composition, 458
improvement (P), 121
index, 742
winter-grade, tests, 1905
Lubricating emulsions, 467, 468
Lubricating greases:
aluminium, 144, (P) 876
curve, 469
hub-wedge, 469
manufacture (P), 876, 1072, 1202, 1289, 1689
strontium, 751
viscosity characteristics, 133
Lubrication:
absorbed films, diffraction patterns, 1904
adsorbed layer action, 1108
bearing: (P), 876
plain, 143
boundary, production, 1502
coefficient of rolling friction, 465
development, 460
friction and wear, 1109
gear, selective (P), 680
gear-boxes, pre-selective, 901
Lubrication—*cont.*
hydrodynamic, 1103
oil spread, 462, 754
pads for (P), 680
Reynolds equations, 1104, 1105
steam turbines:
demulsibility significance, 1216
oil cooling function, 466, 902
rusting, 1709
turbines, 755
vade mecum, 142

McClosky, Illinois, 235
McIlhiney chlorination, ferrocyanide as reducing agent, 1087
Magna–Tector, 1387
Manchuria, Fushun oil shale, 1241
Maracaibo, Venezuela, 1670
Marketing, world oil, 1527
Mata Grande, Venezuela, 1669
Mattoon, Illinois, 771
Medicine Hat gas field, Alberta, 1765
Mene Grande, Venezuela, 35, 515
Mercaptans:
manufacture (P), 1289
vapours disposal, 1302
Metal sulphonates, dry, manufacture (P), 1289
Metering, fluid (P), 718
Methane:
accommodation coefficients, 280
chlorides (P), 876
conversion, 875
motor fuel, 165
reagent in Fischer–Tropsch process, 1195
Methane-*n*-butane, phase equilibria, 731
Methane-*n*-butane-decane, phase equilibria, 614
Methane–ethane, expansion, 446
Methyl groups, barrier values, 277
3-Methyl-butyl 2-ethyl-hexyl orthophosphate, aromatic amine salt (P), 876
Methyl*cyclo*hexane:
heat capacity, 619
infra-red absorption, 1076
vapour pressure and density, 1311
Methyl*cyclo*pentane:
infra-red absorption, 1076
vapour pressure and density, 1311
2-Methyl-1-heptene, infra-red spectra, 1695
6-Methyl-1-heptene, infra-red spectra, 1695
Methylpentane, isomerization (P), 727
Methylthiophene, physical properties, 618
Metrovick jet engine, 1222
Mexico:
exploration, 699, 1545
Government oil organization, 494
oil industry, 1052
Pemex developments, 1147
petroleum production, 244, 711, 1451, 1653
well completions, 710

Michigan :
Afton–Onaway area, 772
developments, 73, 1738
oil geology, 1548
southeastern, geology, 685
Middle East :
developments, 1284
oil industry, 713
petroleum reserves, 1575, 1780
Mikhailovsky, U.S.S.R., 785
Mildred–Ruth Lakes, Canada, 1362, 1562, 1761
Mioerhkow, China, 1241
Mississippi :
Brookhaven field, 1549
developments in 1945, 79
marine sediments, 944
Permian basin production, 943
salt domes, geophysical history, 942
Missouri, oil and gas possibilities, 773
Mixtures, two-component, separation (P), 1204
Molecular weight :
correlation with physical properties, 123
determination, 129, 439, 476, 738, 1324
theory, 885, 1079
Molecules :
entropy, 1887
vibrational frequency determination, 1081
Monoalkylacetylenes, determination, 1325
Monoalkylbenzenes :
dihydrogenation, 1191
from benzene alkylation, 724
Monomeric formic acid, infra-red spectra, 1878–9
Montana :
central and N.W., geology, 1732
developments, 77, 1359
Judith Basin, 22
Jurassic–Cretaceous boundary, 21
oilfield geology, 177
Moore oilfield, Oklahoma, 1741
Morocco, French, petroleum production, 1851
Motembo, Cuba, 1654
Motor fuel :
breaking-in (P), 1072
detonation behaviour, electronic indicator, 646
gas, farm manure, 1230
manufacture (P), 1202
methane, 165
stabilization (P), 876
substitute :
cold starting, 1901
in Australia, 480
in France, 499, 500
testing, engine, 1706
See also Gasoline.
Motor Industry Research Association, 758

N.F.B. displacement pump, 546
Napalm gelling agent, 670
Naphtha :
aromatics removal (P), 417
conversion (P), 417
desulphurization (P), 417
Naphthalene, high-pressure hydrogenation, 1296
Naphthalene–tetralin–decalin, analysis, 1326
Naphthenates, manufacture (P), 166
Naphthenic Acids :
distribution in gas oil, 1885
radioactivity effect, 626
Napier Naiad engine, 1713
Natural gas :
ammonia from, 599
analysis :
A.S.T.M., 1091
mass spectroscopy, 1492
dehydration, 891
deviation from Boyle's law, 425
gasoline recovery (P), 1689
mobile laboratory for, 1098
oxygenated chemicals, 478
purification, 1099
storage, in buried pipes, 745
sulphur recovery, 931
synthesis of hydrocarbons, 289
thermal conductivity, 134
transport cost, 384
treatment plant, direct-fired oil heater, 262
volume conversion, 811
United States industry in 1946, 659
Natural gasoline :
absorption plant, 267
evaluation, 268
de-ethanization fat-oil, 269
Netherlands East Indies :
developments, 1856–7
petroleum production, 1682
rehabilitation, 91, 714
New Brunswick, petroleum production, 1831
New Guinea. *See* Papua.
New Mexico :
developments, 70, 86, 1747
gas drive operations, 1261
Langlie, repressuring project, 367
natural gas purification, 1099
Ogallala cap rock, reefs in, 23
Permian correlation, 179
Rattlesnake oilfield, 945
southeastern :
developments, 1755
geology, 1748
New York :
developments, 75, 1744
oil geology, 536
Nigeria, exploration, 1784
Nitric oxide, accommodation coefficients, 280
Nitriles, hydrocarbon, separation (P), 1289
Nitro compounds :
aromatic, catalytic reduction (P), 417
in petroleum distillates, 1303
Nitrolic acids, from mononitroparaffins (P), 417

Nitrous oxide, accommodation coefficients, 280
Nonane, freezing point, 1074
Non-aqueous media, dispersions in, 1882
North Coles Levee, California, 226
North Pinhorn gas field, Alberta, 1765
Nova Scotia, Canada, 1768
Nowata–Claggett oilfield, Oklahoma, 362
Nylon, properties, 1115

*cyclo*Octane, heat of combustion, 1293
*iso*Octane, motor fuel, cold starting, 1901
*cyclo*Octatetraene, 1493
  infra-red and Raman spectrum, 1207
Octene, infra-red spectra, 1695
Oden, Texas, 947
Oficina, Venezuela 515
Ohio, developments, 75, 1744
Oil seals, German, 1925
Oil shale :
  distillation (P), 876
  Fushun, Manchuria, 1241
  retorting, fluid solid technique, 906
  treatment, Swedish method, 479
  treatment (P), 1072
Oilfields, classification, 1014
Oklahoma :
  Anderson–Prichard field, 1357
  Cotton County development, 937
  crude oil–stratigraphy relationship, 507
  Delaware–Childers, secondary recovery, 1406
  developments, 76, 1739
  geophysical survey, 204, 206
  Golden Horse-Shoe, geology, 1740
  Greater Seminole development, 1139
  Howard 1 well, 1355
  Howard well, 1355, 1550
  Lindsay field, 1356
  Moore oilfield, geology, 1741
  Nowata–Claggett, secondary recovery, 362
  Southwest Antioch pool, 1358
  West Cement, unitization, 822
  West Edmond field, 243
  Wheeler oilfield, geology, 1742
iso-Olefin-diolefin interpolymers (P), 876
Oleic acid, production, 725
Oleophobic monolayers, 899, 1312
Olive oil, Bouveault reduction, 1912
Oregon, Upper Nehalem river basin, 24
Oregon Basin oilfield, Wyoming, 1733
Organic acids, complex salts (P), 166
Organic liquids, solubilization by detergents, 146
Organographites, X-ray diffraction study, 1209
Origin of petroleum, 1690, 1724
  bacteria in, 54, 222, 821, 1532, 1612, 1720
  carbon isotopes and, 185
  clay mineralogy, 1721
  hydrocarbons from fatty acids, 1
  organic material transformation, 7
  redox potential of marine sediments, 6
Orthobaric density, power laws, 1206
Oxygen, accommodation coefficients, 280
Oxidation inhibitor (P), 876, 1072

P.V.C., properties, 1115
Palestine, exploration, 1378, 1781
Panama :
  exploration, 1564
  Sinclair concession, 833
  tectonics, 31
Papua :
  exploration, 1379
  oil industry reconstruction, 91
Paraffin wax. *See* Wax.
Paraguay :
  exploration, 1572
  Santa Rosa, exploration, 1373
Patoka, Illinois, 235
Pechelbronn oilfield, France, 1843
Pennsylvania :
  Bradford, developments, 816, 823, 831, 921
  developments, 75, 537–8, 1744
  production data, 1126
1 : 3-Pentadiene, infra-red spectra, 1694
Pentanes, isomerization (P), 121
*cyclo*Pentane :
  from piperylene (P), 417
  heat capacity, 619
  heat of combustion, 1293
  infra-red absorption, 1076
  vapour pressure and density, 1311
*cyclo*Pentane-neohexane–aniline, study of, 611
*iso*Pentane :
  alkylation, 116, 622
  from *n*-pentane, 413
n-Pentane :
  boron fluoride solubility, 613
  isomerization (P), 1289
  *iso*pentane from, 413
2-Pentane :
  isoforming, 112
  isomerization, 112
Pentenes :
  heat capacities, 1294
  pyrolysis, 615
*cyclo*Pentene, from *cyclo*pentane (P), 1289
Perco catalytic desulphurization process, 275
Permeameter, Sun, 376
Peroxides, ditertiary (P), 1689
Perspex, properties, 1115
Peru :
  developments, 1835
  exploration, 1573, 1772
  Ganzo Azul, 1573
  petroleum production, 573, 711, 1456–8, 1662–4
  Puerto Oriente, 1573
  Santa Clara, 1573
  southeastern, geology, 34
  tectonics, 31
Petroleum chemicals :
  British plants, 872, 873, 1182
  developments, 293–4, 1338
  fluorine, 1906
  Gulf Coast, 1337
  Hydrocol process, 1906

Petroleum chemicals—*cont.*
manufacture, 477, 907
rubber, 1069
Shell Chemical Corpn. plant, 294
U.S.A. developments, 294, 1483, 1872
uses, 905
Petroleum geology :
aerial photography, 766–7, 936
application : 12
to reservoir analysis, 368
clay mineralogy, 1721
conodonts as guide fossils, 3
continental shelves, 933, 1135
origin, 4
core analysis :
electrical resistivity, 696
freezing cores, 527
crude oil–stratigraphy relationship, 507
diastrophic activity in Gulf Coast, 684
dolomites :
differentiation from calcite, 1495
replacement, 961
evolution of, 932
exploration :
bacteriological analysis, 785
methods, 1722
fault structures, 175, 1723
gas migration thermodynamics, 194
geological sections, vertical scale exaggeration, 681
geosynclines, 952
geothermal gradients, 941
grain roundness application, 8
limestones :
porosity, 5
spectrochemical logging, 182
log map, 682
marine fauna in gypsum, 170
marine sediments, redox potentials, 6
micropalæontology, 939
oceans and continents, distribution, 327
Ogallala cap rock, seep in, 23
oil accumulation, thrust–shatter theory, 1745
oil discovery :
fluorescent technique, 978
submarine slumping, 2
oil sands, clay content, 534
oil search needs, 1345
origin of petroleum. *See* Origin of Petroleum.
palæontologists activities, 10, 1133
Permian correlation in Texas/New Mexico, 179
platform structures, 464
pressure on sea-bed measurement, 935
reservoirs, classification, 169
rocks, permeability measurement, 376
salt domes, 934, 942, 1138
sediments, correlation, 955
source material accumulation, 329, 1724
strata correlation, insoluble residue terminology, 1725
stratigraphy, fossil fish in, 1238
structure mapping aerial photography, 766
Petroleum geology—*cont.*
territorial units, 171
Tertiary marine sedimentary cycles, 944
Petroleum industry, progress of 100 years, 1526
Petter–Fielding engine, 1221
Phenol–brine mixture, phenol recovery (P), 1072
Phenolic compounds, manufacture (P), 417, 1202
Phenols :
alkylation (P), 1202
extraction, Phenosolvan process, 1193
Phenosolvan process, 1193
Phenyl acetylene, absorption spectra, 1889
1-Phenylalkane, molecular volume, 124
2-Phenylalkane, molecular volume, 124
Phenylbutenes, from benzene–butadiene (P), 417
Phenyl cyanide, absorption spectra, 1889
Phenyl *iso*cyanate, absorption spectra, 1889
Phenyleicosanes, preparation, 1297
Philippines, Cebu oil discovery, 1584
Pipelines :
aerial patrol, 1859
Argentina, 1056
automatic control, 1858
China–India, 857
corrosion, 1683
protection, 98, 257–8
cutter (P), 718
design, 94–7
electrically-operated, 1861
engines, diesel, 488
flow chart for pressures, 97
helium, Bureau of Mines, 100
natural gas, 1055
butt-welded, 578
compressors, 1060, 1178, 1474
Kettleman Hills–Los Medranos, 93
paraffin removal by salt, 377
pipe data, 259
Portland–Montreal, 1858
pressure drop, 883
pumps, plunger, variable capacity, 1860
repair (P), 680
submarine loading, 857
technology, 256
transfer, pressure drop, 716
United States, 92
valve (P), 1059
wartime technology, 855
world construction, 577
Piperylene, *cyclo*pentane separation (P), 417
Plastic flow, 428–30
Plastics, from petroleum, statistics, 475
Poland :
gas discovery, 1154, 1463
oilfield geology, 38
petroleum production, 835
Polar diesel engine, 761, 1515
Polishes, furniture, 149

Polyform process, 587–9
Polymerics, curing (P), 1689
Polymerization :
  benzoyl peroxide decomposition, 1867–8
  butadiene, photochemical, 426
  converted U.O.P. isomerization unit, 1189, 1482
  correlation of variables, 272
  ethylene (P), 417
  olefins (P), 121, 417
  plant conversion from isomerization unit, 586
  process (P), 417, 876, 1072, 1202
  propylene (P), 121
Polymers :
  high molecular weight (P), 1289
  hydrocarbon, 1117, 1118, (P) 1202
  resinous, 1118
  treatment (P), 417
Polystyrene, properties, 1115
Polythene, properties, 1115
Pool, definition, 1014
Pratt and Whitney Wasp engine, 1340
Pressure–volume relationship, 1890
Production of petroleum :
  abandoned wells, danger of, 1257
  acidizing, 234, 1016
    mud, 1265–7, 1404
    water intake increase, 345
  air drive, 223
  air–gas drive, 807–8, 1259, 1406
    water–flood following, 826
  bacteria in, 54, 222, 821, 1532, 1612, (P) 1047
  bottom-hole pressure calculation,, 1018
  brine density, temperature effect, 1618
  capped well re-sealing, 62
  cementing, plastics in, 1620
  clay permeability, 800
  completion :
    multiple (P), 707
    technique, 1015, 1405
  core examination, quick-freeze seal, 803
  cores :
    oil saturation, 1414
    water estimation, 1416
  costs, 493
  crude oil treatment, 350, 351, 353, 1428
  cycling :
    economics, 1817–8
    gas injection, 1410
    recovery from retrograde reservoir, 1420
    unitized, 261
  decline curves, 55, 1813
  definitions of terms, 1014
  difficulties, 1611
  dual completions, 348, 1409
    remedial work, 1815
  engineering developments, 53, 219–20
  explosives in, 1608
  flow in sands, temperature effect, 802
  formation testing, 1255
Production of petroleum—*cont.*
  gas :
    dual completions, 1023
    flow charts, 1017
    testing back pressure, 1263
  gas condensate reservoirs, 1820
    equilibrium factors, 1163
    fluid flow, 1162
    reserve fluid, 543
    valuation, 542
    well data, 221
  gas conservation, 65
  gas drive, 1260, 1261
    Cunningham oilfield, Kansas, 556
    dry gas reinjection, 1262
    gas injection, 344
    gas recovery, 228
    gas required, 544
    gas treatment, 352
    nitrogen for, 1823
    pressure maintenance, 1032
    use of old wells, 1044
  gas gathering system, hydrate plugging, 1024
  gas lift :
    continuous flow, 1264
    thermodynamics, 1411
  gun perforation :
    design, 1022
    factors in, 1413
  hydrodynamics, 1401
  interstitial waters movement of, 236
  logging. *See* Drilling.
  methods, 88
  mud acid, composition, 1027
  mud removal, 1029
  natural gas, volume conversion, 811
  oil and connate water determination, 1616
  oil detection, fluorologs, 1590
  oil sand permeability, 534, 539
  organization, 1402
  packer problems, 1028, 1165
  paraffin elimination, 60
  percolation through porous media, 1253
  permeability :
    determination, 376, 1030
    increase, 799
    mud effect, 1029
    X-ray measurement, 1424
  plugging :
    agents, 356, 813
    chemical, 225, 1426
    plastics, 1268
    smokes, 224, 1031
  pressure, bottom-hole, 1607
  pressure controlled intermitters, 227
  pressure maintenance, 226, 551, 1427, 1614
  pressure–temperature–gravity relation, 805, 806
  pumping, sucker rod stretch, 1035–6
  remote control, 1613, 1821
  research laboratory, 378
  reserves, estimation, 349
  reservoir analysis, 368

Production of petroleum—*cont.*
reservoir behaviour :
core analysis, 1019
well-bore effects, 1421
reservoir fluids, analysis, 1164
reservoirs :
bottom water-drive, 1045
electric analogy, 1415
fluid control, 557
gas-condensate, 370
gas-drive, crude gravity effect, 1025
performance, physical properties correlations, 1197
pressure, high, 1422
salt water disposal, 64, 375
sand consolidation, 1417–8, 1617
secondary recovery :
calculations, 362
capillary diaphragms, 817
capillary pressure, 820
plugging agents, 355, 356
pump selection, 357
research, 231, 553
unitized, 552
use of old wells, 361
water exclusion in input wells, 1277
shooting, 1269–71
marble, 1812
selective, 535
stripper wells, cleaning, 1273
unit operation, 1033
volumetric behaviour, 1419
water, sulphate reduction, 237
water control, top, 1281
water drive : 232, 235, 816, 823, 1043, 1166–8, 1276, 1279, 1619
after air–gas drive, 826
algæ control, 1825
brine advantages, 1429
channeling and by-passing, 555, 558
chemical agents, 819, 1435
clay studies, 1037, 1038, 1275
displacement and invasion factors, 564
dissolved iron effect, 1436
dry-oil recovery, 359
economics, 229, 233
elongated reservoir, 1431–2
flowing production, 374
free pump use, 1826
hazards, 1437
intake rate, 234
interfacial tension reduction, 819, 1435
interference between wells, 561
methods, 373
migration of oil, 1040
oil ahead of water, 372
pressure gradient effect, 825, 1278
producing rate by expansion, 560
pumping plant, 550
radial reservoir, 565
recovery–well spacing relation, 369
research, 360, 1434
reservoir division, 1274
reservoir pressure decline, 559
specific injectivity index, 360
Production of petroleum—*cont.*
water drive—*cont.*
suspended matter in water, 371
tools for, 1430
two-pay intervals, 1042
use of old wells, 1044
water characteristics, 554
water pH effect, 818, 824, 827
water pressure effect, 1280
water requirements, 1039
water treatment, 1433
well capacity, 562, 563
well location, 1041
wells :
cleaning, 1256
gun-perforated, cleaning, 540
spacing and recovery, 230, 369
wax removal, 1615
work over planning, 1606
Production equipment :
artificial lift, 1258
barges, 1046
blow-out remedy, 792
casing, stress effect, 1814
cleaner, well (P), 1047
compressors, shaft treatment, 1403
corrosion : 346, 809–10, 1163, 1438, 1609–10
protection, 56–7, 260, 346–7, 1408, 1816
developments, 1161
engines, diesel, 488
flow controller (P), 66, 707
fluid separator (P), 707
foam suppression (P), 1047
gas-lift, 812, (P) 1047
motor, pressure, control (P), 707
oil–water separator, 1020, 1021
packer (P), 707
paraffin removal, 547, (P) 1047
barge equipment, 1046
perforation locator (P), 1047
pipe coupling (P), 66
plug, plastic (P), 707
pressure control (P), 1047
production from depleted fields (P), 1047
pump :
displacement, N.F.B., 546
gas operated (P), 707
hard-faced valve seats, 358
hydraulic (P), 707
walking beam for (P), 707
packing (P), 707
pumping, 1824
electricity distribution, 548, 549
gas engines, 1254
jacks, electric, 545
motors, 1822
power distribution, 815
unit design, 814
rotor valve, 1430
sand screen, 63
scale formation, 58, 59
screen (P), 1047
secondary recovery, surface equipment, 363, 364

Production equipment—*cont.*
shooting (P), 707
shot-hole caliper, 1430
shot-hole core drill, 1430
sucker rod scrapers, 60
sucker rod tightener (P), 707
swabs, 1272
torpedo (P), 1047
tubing :
corrosion, 1438
paraffin removal (P), 707
tubing release (P), 707
tubing scraper, 547
water purification (P), 66
water repellent (P), 1047
well head, 798
Propane :
carbon monoxide reaction, 1308
properties, 1708
*cyclo*Propane, structure, 617, 878, 1078, 1691–2
*iso*Propyl alcohol, purification (P), 417
Propylene :
alkylation (P), 876
from ethylene (P), 417
hydrogen bromine addition, 1299
isoprene from (P), 417
oxidation, catalytic, 1077
polymerization (P), 121, 417, 727
thermal properties, 730
vibrational frequency, 1075
Puenta Hills, California, 15
Puerto Oriente, Peru, 1573
Pulverized fuel, 1909
Pumping :
costs, 1180
pipeline, electric power, 856
Pumping stations, electrification, 99
Pumps :
centrifugal :
performance charts, 1057
performance, viscosity influence, 390
pipeline (P), 718
refinery, 392
Pyridine, absorption spectra, 1888

Qatar, developments, 1284

Railways, dieselization, 1501
Raney nickel catalyst, 629
Rangely, Colorado, 526, 686, 793, 1140, 1244, 1398
Rattlesnake, New Mexico, 945
Refineries :
Co-operative Refinery Assoc., 1479
Gulf Coast, 1286
Haifa, 859
Leonard Refineries Inc., Alma, 1686
Pure Oil Co., Toledo, 107
Sinclair Refining Co., Houston, 113
Refinery plant :
absorbers, plate efficiency, 387, 399
air compressors, safe practices, 385
barrel-drying, 1865
boilers, corrosion cause, 583
compressor, centrifugal, 719
control instruments, air supply, 414
Refinery plant—*cont.*
cooling towers, 1061
design charts, 1177
evaluation, 1863
corrosion control, 386
corrosion protection, plastic, 1475, 1476
counter-current treating (P), 876
cracking. *See* Cracking plant.
crude dehydration, 1862
cyclones, 106
debutanizer design, 1874
desalting, 391
distillation. *See* Distillation.
filter, disc (P), 876
filter, leaf (P), 876
flow controller proportional, 651
furnaces, tube decoking, 388
heat exchangers, heat loss effect, 389
heat losses, 394, 861
hoists, transportable, 865
homogenizer (P), 1202
insulation, 1062
pipe joint (P), 876
power :
electric, 395
steam, 1181
process control instruments, 1874, 1875–6
pumping costs, 1181
pumps :
centrifugal, priming, 1684
design, 392, 1196
operating data, 1179
steam consumption, 1288
vacuum, 1685
servo mechanisms, 416
stacks :
draft, 862–3
size, flue gas temperature, 1063
size, furnace draft, 1064
steels, creep strength, 264
thermal conductivity of materials, 393
transfer line vaporization, 864
tube, diameter and thickness, 263
valve, high-temperature (P), 1289
Refining :
carbonate strength, 1089
caustic soda treatment (P), 1202
caustic strength, 1089
cracking. *See* Cracking.
desulphurization, 582, (P) 121
distillation. *See* Distillation.
doctor solution strength, 1089
feed stocks, basic nitrogen determination, 636
fuel oil in, 896
fuels, heating values, 101
gasoline, sulphuric acid treatment, 594
gasoline-doctor solution, breaking, 581
heat absorption in tube-still furnace, 102
hydroforming, 410
instrumentation, 1070
Isomate process, 111, 411
isomerization. *See* Isomerization.
pipe still transfer temperatures, 106
process data, 860
solvent refining. *See* Solvent refining.

Refining—*cont.*
sulphuric acid, 594, 1073
transfer-line pressure drop, 716
waste disposal, 396, 579
waste gases, burning, 720
waste water disposal, 103
Region, definition, 1014
Reitbrook oilfield, Germany, 1779
Reservoir, definition, 1014
Resinates, manufacture (P), 166
Resinox plastic for plugging wells, 355
Resins :
chlorinated hydrocarbon, 318–9
synthetic (P), 1072
Resistolog electrical survey, 967
Rheology. *See* Viscosity.
Richard King field, South Texas, 1034
Road construction :
asphalt–concrete, 668
asphalt macadam, 667
bitumen specifications, 1217
bituminous, cotton fabric in, 669
joint filler, rubber–asphalt, 903
mobile hot mix asphalt plant, 471
Rocket propulsion, energy evolution, 882
Rockets, German and Japanese, 1236
Rolls-Royce Eagle engine, 911
Rolls-Royce Nene engine, 760
Roma, Queensland, 1789
Rose Hill oilfield, Virginia, 1746
Roumania :
drilling, 842
oilfield geology, 38
petroleum production, 678, 835, 1464–5, 1849–50
Soviet–Roumanian Oil Co., 1465
Rubber, synthetic :
butadiene, research, 295
dimethylstyrene-butadiene copolymers, 671
manufacture (P), 876, 1202, 1289
statistics, 475
Rust preventative oil, 147
Ruston marine engine, 1521

Sabine Pass oilfield, Gulf Coast, 1758
St. Marcet, France, 1844–5
Sakhalin, exploration, 1788
Salt Creek, California, 78, 770
Sampling, apparatus (P), 876
San Pedro, Argentina, 32
San Jose Hills, California, 15
Sand, definition, 1014
Santa Clara, Peru, 1573
Santa Maria, California, 1544
Santa Rosa, Paraguay, 1373
Saudi Arabia :
developments, 713, 1284, 1470
petroleum reserves, 1575, 1578
Schoonebeek, Holland. *See* Coevorden.
Sea, pressure on bed, measurement, 935
Seeligson Ranch, Texas, 1361
Servo mechanisms, design, 416
Shale oil, ichthyolic, evaluation, 1506
Shell Oil Co.'s production laboratory, 378
Ships, motor, 254
Shukkoko, Formosa, China, 1241
Siggins, Illinois, 235
Sludge :
aluminium chloride, hydrocarbon recovery (P), 1689
separation, centrifugal (P), 680
Sludge coke, treatment (P), 876
Slushing oil (P), 876
Smoke-point, organic substances, 125
Soap-thickened oils (P), 876
Soaps :
refractive indexes, 1700
water insoluble (P), 1289
Soil stabilization, tests for, 887
Solexol solvent extraction process, 585
Solidified oils (P), 1202
Solids, surface, 122
Solubility, set time and particle size, 1080
Solvent dewaxing :
wax crystal formation (P), 1202
wax purification (P), 1289
Solvent refining, 748
furfural plant, 1479
furfural-water analysis, 658
furfural-water solvent (P), 1289
nitro*cyclo*hexane as solvent (P), 1289
non-mineral oils, 585
process (P), 876
Solexol process, 585
stage estimation, 1491
Solvents :
benzene, industrial risks, 1198
industrial, recovery, 407
Sound velocity and absorption measurement, 1704
South America :
oil resources, 948
palæogeography, 1366
tectonics, 31
South Haldeman, Texas, 1556
Southwest Antioch, Oklahoma, 1358
Spain, exploration, 1375, 1581
Specific dispersion, calculation, 631
Specific gravity, conversion of A.P.I. degrees, 436
Spectroscopy :
absorption apparatus (P), 417
analysis of binary mixtures, 637
application to hydrocarbons, 886
gas blending apparatus, 1088
gasoline, 438
hydrocarbon solubilization, 1702
hydrogen discharge, analysis of C_8 aromatics, 889
industrial, 881
infra-red, 287, 1090
application to hydrocarbons, 443, 639, 1328–30
dual path analysers, 1707
limited radiation analysers, 1211
logging limestones, 182
mass, 1331, 1900
natural gas, 1492
temperature effect, 1701
Raman spectra, 1897
hydrocarbon mixtures, 642
polarization measurement, 1898
thermodynamic data calculation, 432

Styrene :
absorption spectra, 1889
azeotropic purification, 597
drying, 1505
fractionation (P), 1689
from benzene-acetylene (P), 417
from ethylbenzene dehydrogenation, 604
reaction with magnesium perchlorate, 1505
Steam-carbon system, reaction kinetics, 606
Steam turbines :
lubrication :
demulsibility significance, 1216
rusting, 1709
Stearic acid :
molecular layers, lubricating properties, 900
production, 725
Stony Creek, New Brunswick, 1652
Storage installations, fires in, 1199–1201
Storage, oil, on G.W. Rly., 1232
Strontium greases, 751
Sulpho succinates, production (P), 876
Sulphonates :
aliphatic (P), 1689
metal, oil soluble (P), 417
organic, manufacture (P), 1289
petroleum (P), 876, 1289
analysis, 634
Sulphur :
copper strip corrosion, tests, 1705
determination in organic compounds, 1333
elementary, determination in gasoline 643
organic, determination, 640
Sulphur compounds :
alkyl disulphide, determination, 632
mercaptan determination, 633
Sulphur dioxide, from alkylation sludge (P), 876
Sumatra :
oil industry reconstruction, 91
oilfield geology, 40
Sun Permeameter for measuring permeability, 376
Sunniland oilfield, N. Florida, 176
Surface tension :
determination (P), 417
diffusion rôle, 282
liquids, 1703
measurement, centrifugal method, 1094
power laws, 1206
Suspensoid catalytic cracking plant, 1866
Sweden :
exploration, 1580, 1582
motor fuels, 893
oil shale treatment, 479
petroleum in post-war economy, 1235
Synthesis :
developments, 1496
German plants, 870, 1871
Koppers process, 1194
low-boiling hydrocarbons, 630
process (P), 1289, 1689
Synthesis—*cont.*
Synthol process, 1484
U.S.A. plants, 870
See also Fischer–Tropsch.
Synthol process, 1484
Szechuan, China, 1241

Taber, Canada, 1769
Tankers :
Auricula, boiler oil used in diesels, 1718
engines, diesel, 488
world statistics, 383
Tanks :
aircraft, magnesium, 255
storage :
bottom cathodic protection, 1472
breather valve (P), 718
construction (P), 718, 1689
corrosion protection, 1058
fires in, 1199–1201
fire control, 1071
gas, underground cells, 1473
magnesium, welded, 717
pressure, 853
pressure control (P), 1059
repair, 853
Tar, lignite, evaluation, 757
Tarakan, petroleum production, 1857
Tarini, China, 1241
Tennessee :
developments in 1945, 75
Lower Middle Ordivician, 28
Terpene, monocyclic, conversion to *p*-cymene (P), 417
Testing instruments :
electrical, 1896
optical, 1894
thermal, 1895
Tetraethylbiphenyl, 1304
Tetraethylmethane, 1305
Tetralin, high pressure hydrogenation, 1296
Texas :
Carthage gas field, 1048, 1412, 1551
developments in 1945, 81–6
East :
developments, 1750
oil discovery near Jackson, 1360
oil in San Augustine County, 1555
production problems, 801, 1026
salt water disposal, 375
gas drive operations, 1260–1
geophysical surveys, 207
Gulf Coast, developments, 1754
Hawkins oilfield, 178, 354
Hull and Silk field, repressuring programme, 365
Katy field, 26
La Gloria oilfield, geophysical history, 997
Loma Alto–Seven Sisters, Resistolog survey, 967
Lovell Lake oilfield, 966
natural gas reserves and production, 80, 1830
North, water drive possibilities, 373

Texas—*cont.*
north and west central, developments, 1751
Odem oilfield, 947
Ogallala cap rock, reefs in, 23
Panhandle, developments, 1752
Richard King field, 1034
Rincon field, pressure maintenance, 1427
Seeligson Ranch discovery, 1361
South :
Agua Dulce to La Gloria fields, 1049
developments, 1753
South Haldeman field, 1556
southwest, production developments, 379
Waller Co., 27
Waskom, dual completions, 1409
water-drive projects, 1043
West :
core analysis, 688
Delaware oil prospects, 1552
developments, 1755
Fullerton field, pressure maintenance effect, 551
Permian correlation, 179
seismic exploration, 1158
West Pampas, repressuring, 366
Woodson field, water drive, 1279
Theseus engine, 912
Thiophane, from thiophene (P), 876
Thiophene, alkylation, 621
Thornton aero engine research laboratory, 1228
Thornycroft marine diesels, 1520
Tibu, Colombia, 1569–70
Toluene :
absorption spectra, 1888
azeotropic distillation (P), 1689
C–H-bond energy, 1881
from benzene-aromatics mixture (P), 121
from benzene–methane (P), 727
from coal-tar products, 419
manufacture (P), 121, 876, 1289
Transformer oil, dehydration (P), 121
Transport of oil, pipeline. *See* Pipelines.
Transylvania, gas field geology, 38
Tri*iso*butylene, manufacture (P), 1689
2 : 2 : 3-Trimethylbutane :
heat capacities, 1292
manufacture (P), 727
cis-1 : 2 : 4-Trimethyl*cyclo*pentane, infra-red absorption, 1076
1 : 1 : 2-Trimethyl*cyclo*propane, preparation, 620
Trimethylethylene, isoprene from (P), 417
2 : 2 : 4-Trimethyl-1-pentane, infra-red spectra, 1695
Trinidad :
petroleum production, 711
Tank Farm area, 1136
Triptane, manufacture (P), 1072
Tsungari, China, 1241
Tucupido, Venezuela, 1574
Tuimazy, U.S.S.R., 1174
Tunisia, exploration, 1782
Turbine oil :
additive anti-corrosion (P), 121
oxidation inhibitor (P), 876
Turbines :
lubrication, 466
oil cooling, 755, 902
TXL oilfield, 508
Tzyeliusing, China, 1241

U.S.S.R. :
aircraft engines, 486
Don bend, geology, 957
Emba production, 1675
exploration, 843–7
Karataou uplift tectonics, 962
Kazakhstan, geology, 956
Maikop beds, age, 180
Mikhailovsky gas field, 785
Moscow Palæozoic depression, 959
Near-Caspian depression, 1374
oil-shale reserves, 843
petroleum production, 835, 1283, 1676
petroleum reserves, 847, 1054, 1175, 1575, 1780
River Juriazan, geology, 958
Sarabikulovo, 1243
South Emba region, geology, 326
Timan, geology, 960
Tuimazy oilfield, 1174
Ural region, replacement dolomites, 961
Volga region, replacement dolomites, 961
Ultrasonic propagation in liquids, 1704
United States :
Andarko basin, geology, 504
Appalachian area :
developments in 1945, 75, 1805–6
oil geology, 536
Atlantic Coast, developments, 1743
Chicago oil companies, 1125
continent shelf area, 172, 1135
Corpus Christi–Cornwell gas pipeline, 578
drilling outlook, 1829
Eastern Interior basin, developments in 1945, 68
eastern seaboard, natural gas market, 1924
exploration, 830
gasoline :
octane rating trends, 1100, 1902
quality and supply, 1131
synthesis, 870
geophysical surveys, 1587
Gulf Coast :
continental shelf, 1758
development, 1137–8
diastrophic activity, 684
geothermal gradients, 941, 1793
marine drilling, 1554
oil geology, 940, 1553, 1749
oilfields, 709
petroleum chemicals industry, 1337
refineries, 1286
submarine exploration, 783, 784

United States—*cont.*
natural gas :
industry, 659, 1629
natural gasoline, economics, 1132
plants, 1528
reserves, 746, 1639
Mid-Continent :
developments in 1945, 74
geothermal gradients, 941, 1793
water flood trends, 61
north-eastern, structure development, 768
oil developments 1946, 1347
oil exploration costs, 1346
oil industry, 320
oil production costs, 493
oil reserves, 1124
oil search needs, 1345
petroleum chemicals plants, 294, 1483, 1872
petroleum industry, 920, 1929
petroleum production, 239–40, 323, 1443–5, 1626–8, 1641, 1647–9
petroleum reserves, 829, 1349–50, 1444–5, 1447, 1534, 1538, 1541, 1543, 1644
petroleum trade, 1929
pipeline construction, 92, 577
railway dieselization, 1501
refinery yield trends, 679
research :
chemical, 164
petroleum, 498
Rocky Mountain :
developments, 77, 1359
oilfield geology, 946, 1730
well completions, 67–79, 81–6, 241, 568–70, 708, 828, 1143–4, 1169–70, 1348, 1351–2, 1440–2, 1446, 1533, 1535–7, 1539–40, 1542, 1624–5, 1630–8, 1640, 1643, 1726–8, 1828
See also individual States.
Universal Oil Products Co., hydrocarbon research, 616
Utah, Vinta Mountains, stratigraphy, 29

Vacuum gauge, 1323
Valves :
design, 858
self-lubricating (P), 680
Vaporization, intermolecular forces and energies, 1891
Velasquez, Colombia, 1571
Venezuela :
Amana oilfield, 950
Barinas, exploration, 513
Bolivar Coastal oilfield, 35
Curazao, deepest well, 776
eastern, 1671
exploration, 1150, 1773
geology, 1239
Greater Oficina, exploitation, 515
Guario oilfield, 1838
Guico oilfield, 1838
Lake Maracaibo, drilling in, 1002
Los Cerritos, exploration, 514
Maracaibo, 35, 1670

Venezuela—*cont.*
Mata Grande, 1669
Mene Grande oilfield, 35
Pelayo concession, 1574
petroleum industry, 1127–8
petroleum production, 249–50, 834, 1459–60, 1665–8, 1836–7
reserves, 1460
Socony-Vacuum operations, 1838
tectonics, 31
West Tana field, 694
Ventura Avenue, California, 1422
Viking gas field, Alberta, 1765
Vinyl alkyl ethers, 756
Virginia :
Lower Middle Ordivician, 28
Rose Hill oilfield, 1746
Viscometer :
Bingham, 1096
capillary type, 1335
rotational, 1334
variable speed, 1095
spinning cup (P), 1202
U-tube for pure hydrocarbons, 608
Viscosity :
asphalt, 1092–3
ballister, 1212
continuum theory, 749
dielectrics, 897
dimethylsiloxane polymers, 503
electric field effect, 664
gases, high pressure, 1487
kinematic, conversion, 741
kinetic energy correction, 1084
linear functions of velocity, 1106
lubricants, 1710
non-Newtonian, 1111
power laws, 1206
pure hydrocarbons, 608
rate process theory, 1693
rheological behaviour and classification, 1892
soap-in-hydrocarbon systems, 890
temperature function, 1210
torque between two concentric spheres, 1107
Viscosity index, comparison with viscosity–temperature characteristics, 742
Viscosity temperature coefficients, 742
Vulcanized composition (P), 1202

Washington, exploration, 1557
Waskom, Texas, 1409
Water :
film coefficients, 434
oil removal (P), 66
Water repellent composition (P), 417
Water–gas reaction, kinetics, 606
Waukesha–Hesselman, low-compression engine, 916
Wax :
application to fruit (P), 876
coating composition (P), 417, 727
crystalline, crack tendency inhibition (P), 121
crystallography, 145

Wax—*cont.*
crystals, from solvent dewaxing (P), 1202
de-oiling (P), 876
manufacture (P), 1689
molecular weight correlation, 123
oxy-aromatic (P), 417
paraffin :
aqueous emulsion (P), 417
chlorinated (P), 876
in rubber and allied industries, 1115
sweating control (P), 876
synthetic (P), 876
use in rubber and allied industries, 909
Welding, resistance, 492
West Cement, Oklahoma, 822
West Edmond, Oklahoma, 243
West Guara, Venezuela, 515
West Newport oilfield, California, 506
West Pampas, Texas, 366
West Tana field, Venezuela, 694
West Virginia :
developments, 75, 1744
natural gas production, 1558
petroleum production, 1559
Wheeler oilfield, Oklahoma, 1742
Wilmington, California, 769, 1405
World :
deepest well, 998, 1634, 1636, 1650
future oil prospects, 517
oilfields, 1282
petroleum atlas, 1827
World—*cont.*
petroleum developments, 1365
petroleum production, 566, 567, 1439, 1449–50, 1621–3
petroleum reserves, 517, 1450
pipeline construction, 577
Wool wax acids, heavy metal soaps, 1913
Wu Su, China, 1241
Wyoming :
developments, 77, 1359
drilling technique, 332
geology, 687
Gros Ventre mountains, stratigraphy, 1729
Oregon Basin oilfield, geology, 1733
Palæozoic formations, 689

Xylene :
absorption spectra, 1888
C–H bond energy, 1881
manufacture (P), 1689
non-aromatics removal (P), 876
m-Xylene :
high pressure hydrogenation, 1296
manufacture (P), 876

Yenchang, China, 1471
Yugoslovakia, petroleum production, 835
Yuman, China, 1241

Zone, definition, 1014

BOOKS REVIEWED AND BOOKS RECEIVED.

Numbers refer to pages.

A.S.T.M. Proceedings, 1946, 384A
A.S.T.M. Standards Including Tentatives, 1946, 294A, 194A
A.S.T.M. Standards on Petroleum Products and Lubricants, 193A
Accounting for Oil Producers, Practical, R. M. Pitcher, 419A
Additive Engine Oils, 43A
Additives, Anti-Wear and Anti-Corrosion, R. J. S. Perry, 42A
Adsorption, C. L. Mantell, 464A
Alkylation, Hydrofluoric Acid, 166A
American Oil Operations Abroad, L. M. Fanning, 464A
American Petroleum Refining, H. S. Bell, 463A.
Argentina Fuel Economy Report, 294A
Asphalt Carpets, Recommendations for Open-Textured, 42A
Asphaltic Concrete, Manual on Hot-Mix, 41A
Asphalts and Allied Substances, H. Abraham, 42A
Australia, Fuel Economy Report, 294A
Austria, Fuel Economy Report, 294A

Bashkiria, The Devonian in, and Prospect of Oil Occurrence Therein, 323A
Bitumens and Aggregates, Adhesion, J. C. Sprague, 383A
Bituminous Mixtures, Test for Soil, E. O. Rhodes and P. F. Phelan, 384A
British Chemical Plant, 419A
British Lubricating Oil and Grease Research Association, Journal, 42A
British Petroleum Equipment, 323A

Chemical Industry, Petroleum as a Base Material for, J. C. G. Boot, 294A
Chemical Plant, Use of Silver in Construction of, J. M. Pirie, 384A
Colombia, La Economia del Petroleo en, A. E. Ospina-Racines, 323A
Conversion of Petroleum, A. W. Sachanen, 243A
Crystal Growth, Theory of and Application to Design of Industrial Crystallisers, N. R. Mukherjee, 384A
Czechoslovakia, Fuel Economy Report, 294A

Denmark, Fuel Economy Report, 42A
Diesel Engine, The Loop Scavenge, H. D. Carter, 383A
Distillation, Steam Consumption in, H. E. Eduljee, 384A
Dnieper-Donetz Depression, Tectonics of Salt Uplifts in, 323A
Drilling, Manual of Uniform Accounting Practice for Contractors, 193A

Economics (Essentials of Petroleum), P. H. Frankel, 165A
Emba Region, Geology and Occurrence of Petroleum in the Russian Shelf, 324A
Emulsions, Practical, H. Bennett, 464A
Engineering, Petroleum, L. C. Uren, 165A
Essentials of Petroleum, P. H. Frankel, 165A
Exploration Geophysics, Early Geophysical Papers of the Society of, L. L. Nettleton, 419A

Fats, Chemical Constitution of Natural, T. P. Hilditch, 294A
Fog, Dispersal of, from Airfield Runways, E. C. Walker and D. A. Fox, 43A

Gas Analysis and Testing of Gaseous Materials, V. J. Altieri, 243A
German Industry Reports, 244A
Germany, Classified List of Industrialists' Reports, 42A
Germany, Fuel Economy Report, 294A
Germany, Petroleum Facilities of, 42A
Germany, Technical Missions to, 43A, 194A, 384A, 420A
Granular Materials, Pneumatic Transport of, G. Hillyar-Russ, 384A
Grease Analysis, R. S. Barnett, *et al.*, 384A
Great Britain, Fuel Economy Report, 42A

Hades and Rapex Burners, History of Development of, W. T. Moore, 43A
Holland, Fuel Economy Report, 42A
Hydrofluoric Acid Alkylation, 166A

Imperial College Engineering Society, Journal, 1946, 384A
Industrial Research, Future of, 43A
Institute of Marine Engineers, Transactions, 294A
Institution of Chemical Engineers, Transactions, 294A
Institution of Mechanical Engineers, Proceedings 1946, 383A
Insulating Oils, Water Determination by Doble Method, F. C. Doble, 384A

Japan, Technical Missions to, 420A

L'Epopee du Petrole, P. M. E. Schmitz, 323A

Lewis's Library Catalogue 1944–46, Supplement to, 383A
Lithology, Contributions to, 193A
Lubricants and the Nation, J. E. Southcombe, 42A
Lubricants, Comprehensive Laboratory Testing of Instrument, G. E. Barker, *et al.*, 384A
Lubricating Oil in Service, Proper Care of, Marine Lubricants Committee, 294A
Lubricating Oils, Solvent Extraction of, H. Ter Meulen, 294A
Lwow, Centenary of the Technical University, 42A

Methane, Chemicals from, J. P. Lawrie, 167A
Moscou, Bulletin de la Société des Naturalistes de, 323A

National Lubricating Oil & Grease Federation, Journal of, 42A

Oil Across the World, C. M. Wilson, 419A
Oil in Your Future, 43A
Oilfield Development, L. C. Uren, 165A
Operation Pluto, A. C. Hartley, 383A
Organic Compounds, A New Notation and Enumeration System for, G. M. Dyson, 464A

Petroleum Almanac, 323A
Petroleum Industry, J. Perry, 419A
Petroleum Production, Vol. II, Park J. Jones, 243A
Petroleum Statistics 1947, Twentieth Century, 383A
Phosphate Coatings as a Basis for Painting Steel, Recommendations for, 43A
Physical Chemistry, An Introduction to, O. Maass and E. W. R. Steacie, 41A
Post-War Oil Supplies, H. Moore, 42A
Pressure Vessels, Design of Class I, E. J. Heeley, 383A
Pressure Vessels, Design Stresses in Welded, S. F. Dorey, 383A

Scientific Instruments, H. J. Cooper, 243A
Silicon Iron Pipes and Pipe Fittings, Acid Resisting. B.S. 1333 : 1946, 43A
Silicones, An Introduction to the Chemistry of the, E. G. Rochow, 464A
Spheres, The Packing of, H. Heywood, 384A
Sweden, Working Conditions in, C. R. Black, 384A
Sweden, Fuel Economy Report, 42A
Swedish Wood Industry, Impressions of, D. H. Eastland, 384A
Synthetic-Resin Bonded-Paper Sheet. B.S. 1321 : 1946, 43A

Tanker Design, Evolution of, W. L. Nelson, 294A
Texas Oil and Gas, Important Facts About, 42A
Those Who Know You Think Well of You, 419A

Vapour Adsorption, E. Ledoux, 419A
Vapours, The Recovery of, C. S. Robinson, 243A
Volga Region, Problems of Geology and Development of Petroleum Deposits, V. G. Vasil'ev, 324A

Water Used in Steam Generation, Methods of Sampling. B.S. 1328 : 1946, 43A
When The Oil Wells Run Dry, W. M. Fuchs, 323A

APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

JANUARY, 1947.

The following have applied for admission or transfer to the Institute. In accordance with the By-laws, the proposals will not be considered until the lapse of at least one month after the publication of this *Journal*, during which time any Fellow, Member, or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of the candidate.

The object of this information is to assist the Council in grading the candidate according to the class of membership.

The names of candidates' proposers and seconders are given in parenthesis.

Applications for Membership.

ASHMAN, Stanley Ernest, Refinery Shift Supervisor, London & Thames Haven Oil Wharves, Ltd. (*E. G. Hannah; E. Hunting.*)

BUNING, Harm Leopold, Technical Adviser, Royal Dutch Shell Group, Hamburg. (*J. A. Oriel; J. S. Jackson.*)

COBLEY, Ronald Charles, Process Engineer, Manchester Oil Refinery Ltd. (*E. J. Dunstan; E. S. Sellers.*)

DODD, Alfred Herbert, Chief Chemist & Director of Research, Newton, Chambers & Co. Ltd. (*W. W. Goulston; J. S. Jackson.*)

DUGDALE-BRADLEY, John Oliver, Chief Engineer, Stanlow Refinery, "Shell" Refining & Marketing Co. Ltd. (*J. A. Oriel; E. LeQ. Herbert.*)

FOURET, Emile, Chief Chemist, Société des Pétroles Jupiter-Shell.

HECKMAN, Maxwell, Technical Representative, Wilson, Sons & Co. Ltd. at Rio de Janeiro. (*J. T. T. Robinson; B. G. Banks.*)

HINE, Edmund, Chartered Accountant, Petrocarbon Ltd. and Manchester Oil Refinery Ltd. Group. (*E. J. Dunstan; G. H. Harries.*)

HUTTON, Horatio W., Managing Director, Hydrol Chemical Co. Ltd. (*F. H. Rogers; P. H. Snow.*)

KURDI, Hamdi El, Lubricating Sales Co-ordinator, Standard Oil Co. of Egypt Ltd. (*M. A. Selim; J. E. Jenkin.*)

LAMBERT, Charles Edward, Chief Chemist, New South Wales Railways. (*R. E. Cowles.*)

LONGBOTTOM, Frank William, Process Engineer, Manchester Oil Refinery Ltd. (*T. G. Hunter; A. H. Nissan.*)

OEHL, Victor Gustave, Clerk, Petroleum Board. (*J. S. Jackson; T. C. R. Baker.*)

SUTTON, Robert Henry George, Director & Manager, Urquhart's (1926) Ltd. (*G. R. Llewellyn; R. J. Bressey.*)

TAYLOR, Frank Paul, Chemist, Petroleum Board. (*C. Chilvers; H. N. Harrap.*)

TULLIS, David High, Sales Chemist, Lobitos Oilfields Ltd. (*J. S. Parker; D. M. Glendinning.*)

TYLER, John Wyatt, Petroleum Inspector, Vacuum Oil Co. of South Africa Ltd. (*R. G. Pomeroy; I. H. Versfeld.*)

VISSER, Gerardus Hendricus, Deputy Director of Research, B.P.M. Laboratories, Amsterdam.

WAGNER, Reginald Arthur, Installation Superintendent, British Oil Storage Co. Ltd. (*R. St. A. Griffiths; E. Evans-Jones.*)

WRIGHT, Victor Barry, Chemist, Sternol Ltd. (*A. L. Read; C. H. Hudson.*)

WYLLIE, David, Senior Scientific Officer, Admiralty Chemical Dept (*D. Clayton; P. Kerr.*)

Candidates for Admission as Students.

(Proposed by V. C. Illing.)

DOUGLAS, James Robert, Student, Royal School of Mines.
FOTHERGILL, Colin Arnold, ,, ,, ,, ,,
MARTIN, Richard Ernest, ,, ,, ,, ,,
OWENS, Ronald Ellis, ,, ,, ,, ,,
TAYLOR, Peter Walter, ,, ,, ,, ,,

Applications for Transfer.

BLACK, John Linton, Refinery Manager, Stanlow Refinery, "Shell" Refining & Marketing Co Ltd. (*J. A. Oriel; E. LeQ. Herbert.*) (Member to Fellow.)

BONSTOW, Thomas Lacey, Consulting Engineer, Whitehall Securities Corpn., Ltd. (*G. H. Coxon; A. E. Chambers.*) (Member to Fellow.)

SELLERS, Ernest Stanley, Refinery Superintendent, Manchester Oil Refinery Ltd. (*E. J. Dunstan; G. H. Harries.*) (Member to Fellow.)

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Applications for Membership.

BADDELEY, Denis Irvine, Process Development Chemist, Anglo-Iranian Oil Co., Ltd. (*W. H. Thomas ; O. A. Bell.*)

BROOKBANK, John Anthony, Trainee Plant Chemist, "Shell" Refining & Marketing Co., Ltd. (*W. Cameron ; F. Mackley.*)

COXON, Eric Francis, Research Engineer, Anglo-Iranian Oil Co., Ltd. (*R. Stansfield ; W. H. Thomas.*)

DENT, Thomas Arthur, Assistant Refinery Manager, U.B.O.T. Ltd., Point Fortin. (*J. E. Smith ; S. T. Waite.*)

GREGORY, Frank Gordon, Technical Representative, Marine & Industrial Lubricants, Ltd. (*G. W. D'Arcy Evans ; E. J. Dunstan.*)

HUGGINS, Paul, Chemist-in-charge, Laboratory, Sarawak Oilfields, Ltd. (*C. R. Middleton ; J. Morland.*)

JONES, Charles Edward, Assistant Accountant, National Oil Refineries, Ltd. (*R. B. Southall ; E. J. Horley.*)

MOWLL, John Lewis, Local Secretary, Apex (Trinidad) Oilfields, Ltd. (*A. H. Richard ; H. W. Reid.*)

SHAW, George Bernard, Manager, Industrial Dept., Marine & Industrial Lubricants, Ltd. (*G. W. D'Arcy Evans ; E. J. Dunstan.*)

Candidates for Admission as Students.

BAND, Charles Henry, Student, Chemical Engineering, Birmingham University.

HAGHIGHI, Hushang Ehtesham, Student, Chemical Engineering, Birmingham University.

HAMBLIN, Robert John, Student, Chemical Engineering, Birmingham University.

HIBBERT, Ernest Davy, Student, Chemical Engineering, Birmingham University.

JONES, Peter Frederic, Student, Chemical Engineering, Birmingham University.

JONES, Michael Trevor Balch, Student, Chemical Engineering, Birmingham University.

Transfer.

PICKARD, William Thomas, Petroleum Production Engineer, Anglo-Ecuadorian Oilfields, Ltd. (*S. E. Coomber ; C. D. Hobson.*)

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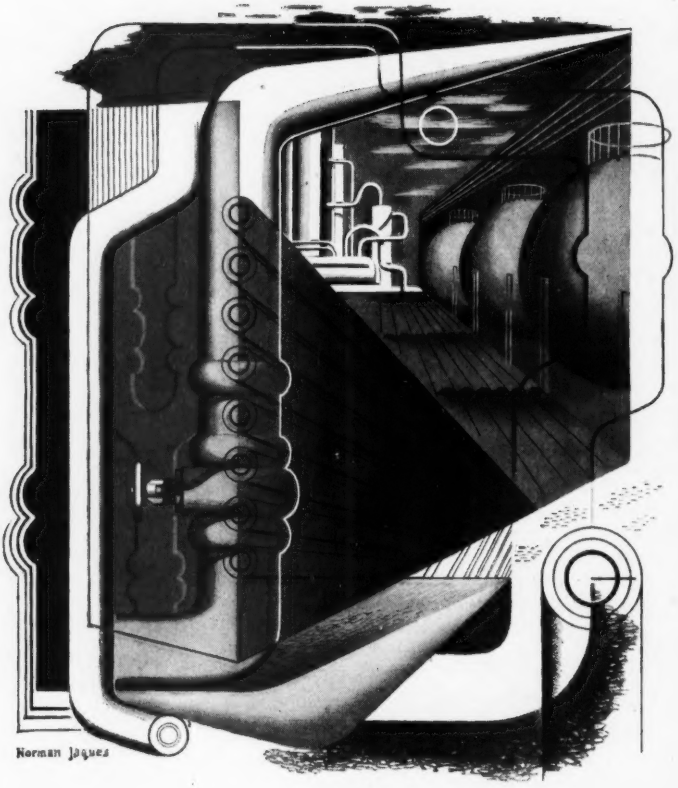

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Applications for Membership.

BALDRY, Ronald James, Trainee, The Petroleum Board. (*R. J. Bressey; J. S. Wilding.*)

DAVIES, Cyril Brynmor, Technical Editor, Aero Engine Laboratory, Thornton Research Centre. (*C. G. Williams; F. L. Garton.*)

DEACON, John Hereward, Trainee Sales Technical Adviser, Shell Petroleum Co. (*G. D. Thacker; R. I. Lewis.*)

FLOYD, Gerald Peel, Company Representative, Anglo-Dutch Petroleum Co. (*R. E. E. Hadlow; J. H. Maltby.*)

GRIFFITHS, Rhys Gwilym, S/Leader, Technical Branch, R.A.F. (*J. Mason; L. Bevan.*)

HAM, Albert John, Chemist-in-Charge, Shell Lubricating Oil Laboratory. (*J. A. Oriel; R. I. Lewis.*)

HELLEWELL, David (Jr.), Manager, John Hellewell & Co. (*T. G. Provest; T. J. Metcalf.*)

HUNT, Thomas William, Research Engineer, British Insulated Callender's Cables, Ltd. (*J. C. Quayle; C. H. Johnson.*)

KIRBY, Alec William Wheatley, Manager, "Shell" Refining & Marketing Co., Ltd., Ardrossan. (*R. I. Lewis; J. A. Oriel.*)

LENAERTS, Joseph, Chemist, A. A. Depauw & Co., Antwerp. (*H. E. Charlton; F. Kind.*)

LOWENSTEIN-LOM, Walter, Chemical Engineer, Stalinovy Zarody, Czechoslovakia. (*L. Ivanovsky.*)

MCNICOL, John Charles, Senior Research Chemist, Motor Industry Research Assoc'n. (*C. G. Williams; E. A. Evans.*)

MARGETTS, Donald Roy Malcolm, Chemist, B. & R. Redwood. (*W. L. Jelffs; A. T. White.*)

MASON, Donald Raymond, Technical Assistant, Anglo-Iranian Oil Company. (*W. H. Thomas; W. A. Partridge.*)

COHEN, Nathan, Analytical Chemist, "Shell" Refining & Marketing Co., Ltd. (*H. E. F. Pracy; D. H. Japes.*)

Candidates for Admission as Students.

Proposed by F. H. Garner.

COLLENETTE, Peter, Student, Birmingham University. (Geology.)

SHEASBY, Gerald Roy, Student, Birmingham University. (Chem. Engineering.)

Proposed by V. C. Illing.

ROBINSON, Frederick David, Student, Royal School of Mines. (Oil Technology.)

ROBINSON, Michael Priaulx, Student, Royal School of Mines. (Oil Technology.)

SIMPSON, George Joseph Howden, Student, Royal School of Mines. (Oil Technology.)

Transfers.

COOPER, Arundel David, Technical Adviser, Shell Petroleum Co. (*R. I. Lewis; J. S. Jackson.*) (*Associate Member to Member.*)

KING, Henry Ernest, Deputy Chief Distribution Engineer, Anglo-Iranian Oil Co., Ltd., Iran. (*C. T. Barber; G. W. Lepper.*) (*Associate Member to Fellow.*)

ROSS, Kenneth Brebner, Works Manager, Anglo-Iranian Oil Co., Ltd., Abadan Refinery. (*M. A. L. Banks; C. E. Spearing.*) (*Associate Member to Fellow.*)

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Applications for Membership.

AUSTIN, Alan Edwin, Chemist, Messrs. W. B. Dick & Co., Ltd. (*P. W. L. Gossling ; J. Romney.*)

BARTH, Edwin Jos., Petroleum and Asphalt Technologist, Wood River Oil Refining Co., Illinois. (*G. Egloff ; G. H. Coxon.*)

BENNETT, Henry Arthur, General Manager, Trinidad Petroleum Development Co., Ltd., Trinidad. (*G. W. Halse ; C. C. Wilson.*)

CHAMBERLAIN, Sydney, Student, University of Birmingham. (*T. G. Hunter ; A. H. Nissan.*)

COLES, Gordon Lemuel, Assistant Manager, Chemical Dept., Petroleum Board. (*F. N. Harrap ; C. Chilvers.*)

GIBALI, Salah El Din El, Engineer, Shell Co. of Egypt, Ltd. (*H. A. Blackmore ; D. R. Howgill.*)

GILMOUR, Hugh, Production Superintendent, Apex (Trinidad) Oilfields, Ltd. (*A. H. Richard ; H. W. Reid.*)

GUPTA, Kishori Lal, Lubrication Engineer, The Delhi Cloth & General Mills Co., Ltd.

HODGSON, Maurice Stuart, Assistant Chemist, "Shell" Refining & Marketing Co., Ltd. (*D. Morten ; K. L. Butcher.*)

KELLEY, John Douglas, Editorial Consultant. (*G. H. Coxon ; F. B. Thole.*)

KINNER, George Henry, Chemist-in-charge, Covent Garden Outstation, Ministry of Supply. (*D. Clayton ; D. M. Duckworth.*)

KORRA, Kamal El Din, Engineer, Shell Co. of Egypt, Ltd. (*H. A. Blackmore ; D. R. Howgill.*)

MACKILLIGIN, Robert Guy Walter, Exploitation Engineering Trainee, United British Oilfields of Trinidad, Ltd. (*J. E. Smith ; F. C. Hamilton.*)

MACLACHLAN, Ronald Ian, Production Engineer, Apex (Trinidad) Oilfields, Ltd. (*H. W. Reid ; A. H. Richard.*)

MILLS, Robert Benjamin, Chemist, Shell Petroleum Co., Ltd. (*W. R. P. Hodgson ; J. Parrish.*)

MURRAY, Frederick, General Manager, Anglo-Dutch Petroleum Co. (Western), Ltd. (*J. H. Maltby ; N. D. Roughsedge.*)

O'DONOGHUE, Denis John, Exploitation Engineer, United British Oilfields of Trinidad, Ltd. (*J. E. Smith ; F. C. Hamilton.*)

PADFIELD, Reginald John, Installation Manager, Shell Wharf, Fulham. (*A. H. Stephenson ; E. P. Lancashire.*)

PIERCY, William Edwin Keith, Manager, Development Dept., Messrs. Albright & Wilson, Ltd. (*A. E. Hope ; F. H. Garner.*)

PINFOLD, Ernest Sheppard, Consulting Geologist, Messrs. Steel Bros. & Co., Ltd. (*J. Mitchell ; G. W. Lepper.*)

REED, Geoffrey Woolmer, Assistant Installation Manager, Shell Co. of Egypt, Ltd. (*H. A. Blackmore ; D. R. Howgill.*)

SMITH, Albert, Plant and Production Chemist, Sternol, Ltd. (*A. L. Read ; G. E. Shelbrooke.*)

WARDLE, Mrs. H. M. L., Experimental Officer, Scientific Civil Service. (*D. Clayton ; D. M. Duckworth.*)

Applications for Transfer.

CAPPER, Max, Technical Representative and Importer in Brazil. (*Member to Fellow.*)

FRANKEL, Paul Herzberg, Managing Director, Raven Oil Co., Ltd. (*E. J. Dunstan ; C. W. Wood.*) (*Member to Fellow.*)

FROST, James, Exploitation Geologist, Trinidad Leaseholds, Ltd., Trinidad. (*Student to Associate Member.*)

TAYLOR, Paul Arthur, Exploitation Engineer, United British Oilfields of Trinidad, Ltd. (*J. E. Smith ; F. C. Hamilton.*) (*Student to Associate Member.*)

LIST OF ADVERTISERS

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ALBRIGHT & WILSON, LTD.	xv
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NORTH AMERICAN GEOPHYSICAL CO.	xxviii
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PULSOMETER ENGINEERING CO., LTD.	xvii
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APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

MAY, 1947.

The following have applied for admission or transfer to the Institute. In accordance with the By-laws, the proposals will not be considered until the lapse of at least one month after the publication of this *Journal*, during which time any Fellow, Member, or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of the candidate.

The object of this information is to assist the Council in grading the candidate according to the class of membership.

The names of candidates' proposers and seconders are given in parenthesis.

Applications for Membership.

BILTON, Norman Frederick, Research Chemist, Vigzol Oil Refining Co. (London), Ltd., Ormskirk. (*L. Mills ; S. Elliman.*)

BIRD, Thomas Reid, Manager, Contracts & Patent Dept., Esso Development Co. (*H. C. Tett ; F. H. Garner.*)

BOORMAN, Edward James, Senior Chemist, Esso European Laboratories. (*C. Chilvers ; A. Osborn.*)

BRANCH, Arthur Charles, Managing Director, Metal Propellers Ltd. (*A. E. Chambers ; T. L. Bonstow.*)

BURNINGHAM, John, Sales Manager, Messrs. Arthur Brown & Co., Ltd. (*F. A. Ostler ; C. B. Wingfield.*)

CULLINGHAM, Ernest Keith, Student, Royal School of Mines. (*S. E. Coomber ; G. D. Hobson.*)

DAVIES, William David, Trainee, Fina Petroleum Products Ltd. (*H. W. Chetwin ; A. J. Wilson.*)

DAWSON, Leonard Smith, General Manager, Oil Well Engineering Co., Ltd. (*R. B. Rogers ; E. G. Thorn.*)

GARDE-HANSEN, Hans, Student, Royal School of Mines. (*S. E. Coomber ; G. D. Hobson.*)

GERSHÓN, John Charles, Sales Manager, Southern Area, Ragosine Oil Co., Ltd. (*G. J. Vineall ; V. M. Farrant.*)

LESTER, Leslie John, Assistant Chemist, Messrs. Arthur Brown & Co., Ltd. (*F. A. Ostler ; C. B. Wingfield.*)

RAIGORODSKY, Paul M., Manager, Claiborne Gasoline Co., Houston, Texas. (*G. Egloff.*)

SELWOOD, Peter, Student, Royal School of Mines. (*S. E. Coomber ; G. D. Hobson.*)

SHEEN, Ronald William, Petroleum Chemist, Messrs. Arthur Brown & Co., Ltd. (*F. A. Ostler ; C. B. Wingfield.*)

Transfer.

CLEGG, Neville Aspinall, Assistant Chief Chemist, Manchester Oil Refinery, Ltd., Manchester. (*Harold Moore ; G. H. Harries*). (*Associate Member to Fellow.*)

LEHNER, Hans Peter Ernst, Prospecting Officer, D.C.O.P., Ministry of Fuel & Power. (*G. D. Hobson ; S. E. Coomber.*) (*Student to Associate Member.*)

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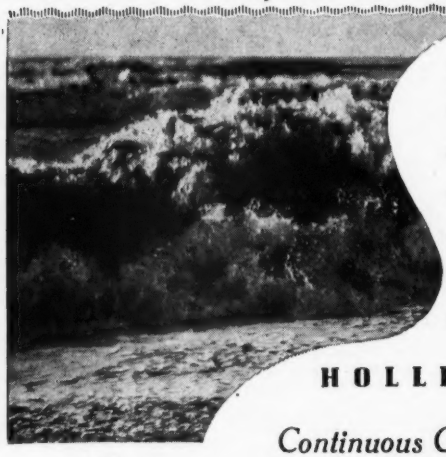

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APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

JUNE, 1947.

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The names of candidates' proposers and seconders are given in parenthesis.

Applications for Membership.

BLUNDELL, Laurence Walter, Superintendent, Gas Light & Coke Co. (*W. G. Adam ; A. K. Steel.*)

BROOKS, Francis Lano, Technical Assistant, Agwi Petroleum Co. Ltd. (*K. Parsonage ; G. Noble.*)

CHARLTON, Douglas Charles, Senior Installation Supervisor, "Shell" Refining & Marketing Co. Ltd. (*J. S. Masters ; E. Fay.*)

CRAWSHAW, Stanley Joffre, Technical Assistant, Shell-Mex & B.P. Ltd. (*F. N. Harrap ; W. B. Rowntree.*)

GILL, Frank, Physicist, Anglo-Indian Oil Co. Ltd. (*D. A. Howes ; F. H. Garner.*)

HILL, John Isaac, Assistant to Chief Chemist, L.N.E.R. (*S. J. M. Auld ; E. A. Evans.*)

LEACH, Ronald Francis, Technical Assistant, Shell-Mex & B.P. Ltd. (*F. N. Harrap ; W. B. Rowntree.*)

MANLY, Frederick Cecil, Works Manager, The Neasden Oil Co. Ltd. (*R. G. de Ferembre ; F. Dakin.*)

MEHTA, Ramkrishan Singh, Chemist, The Attock Oil Co. Ltd.

POLLOCK, John Leslie Nairn, Director, Anglo-American Oil Co. Ltd. (*H. C. Tett ; C. Chilvers.*)

ROGALA, Tadeusz R., Chemical Engineer, Polish Resettlement Corps. (*S. Sulimirski.*)

ROMASZKAN, Kazimierz Jan, Petroleum Engineer, Polish Resettlement Corps. (*S. Sulimirski ; R. K. Oswald.*)

Transfer.

HAWORTH, Alfred John, Geologist, The Texas Oil Co., New York. (*V. C. Illing ; N. F. Brown.*) (*Associate Member to Member.*)

LEVI, Richard, Consulting Chemist, Manchester Oil Refinery Ltd. (*E. J. Dunstan ; G. H. Harries.*) (*Member to Fellow.*)

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APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

JULY, 1947.

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The names of candidates' proposers and seconders are given in parenthesis.

Applications for Membership.

BAGNOLD, Brig. Ralph Alger, Director of Research, Thornton Research Centre. (*J. A. Oriel ; Denis Morten*).

BARNES, Kenneth James Upshall, Works Chemist, Agwi Petroleum Corpn. Ltd. (*G. Noble ; F. Mayo*).

BOX, James Stuart, Chief Metallurgist, Marconi's Wireless Telegraph Co. Ltd. (*E. A. Goodchild ; H. W. Sutton*).

CAIRD, Kenneth Campbell, Stocks Clerk, Petroleum Board. (*E. P. Lancashire ; S. C. Pearson*).

DE VEULLE, Philip Mauger, Executive, Shell Petroleum Co. Ltd. (*H. Hyams ; R. I. Lewis*).

GOVINDAKRISHNAYYA, Pasupuleti, Technical Adviser, Burmah Shell Oil Storage & Distributing Co. of India Ltd. (*R. I. Lewis ; F. L. Garton*).

MURRAY, Graham Francis James, Combustion Engineer, Anglo-Iranian Oil Co. Ltd. (*W. M. Hurrell ; R. Lessing*).

NASH, Reginald Lancelot, Managing Director, Combustions Ltd. (*G. J. Gollin ; R. J. Bressey*).

NOUR, Ahmed el Deen, Chemical Engineer, Shell Co. of Egypt Ltd. (*H. A. Blackmore ; M. S. E. Al-Anwar*).

PRESTON, Frederick Charles, Area Superintendent, Snowdon Sons & Co. Ltd. (*E. R. Redgrove ; J. E. James*).

ROCKE, Harry William, Managing Director, Vacuum Oil Co. Ltd. (*S. J. M. Auld ; A. L. McColl*).

SCHMEIDLER, Jacques, Technical Assistant, Agwi Petroleum Corpn. Ltd. (*G. Noble ; C. R. Young*).

SHERIF, Ibrahim Mohammed Ibrahim El, Assistant Chief Chemist, Egyptian State Railways.

WATKINS, Frederick Francis Charles, Commandant, Army Fire Fighting Centre. (*E. Thornton ; T. M. Simmons*).

Transfer.

CRAGG, John Coles, Production Chemist, C. C. Wakefield & Co. Ltd. (*E. A. Evans ; G. H. Thornley*). (*Member to Fellow*).

SIMKINS, Clarence Reginald Peers, Refinery Foreman, Bahrein Petroleum Co. Ltd. (*Associate Member to Member*).

NEW MEMBERS.

The following elections have been made by the Council in accordance with the ByLaws, Sect. IV, para. 7.

Elections are subject to confirmation in accordance with the By-Laws, Sect. IV, paras. 9 and 10.

As Fellows.

COLES, G. L.
PINFOLD, E. S.

Transfer to Fellow.

FRANKEL, P. H.
ROSS, K. B.

As Members.

BARTH, E. J.
BENNETT, H. A.
DAVIES, C. B.
GILMOUR, H.
HAM, A. J.
KELLEY, J. D.
KINNER, G. H.
KIRBY, A. W. W.
O'DONOGHUE, D. J.

Transfer to Member.

COOPER, A. D.
KING, H. E.
TIRATSOO, E. N.

As Associate Members.

AUSTIN, A. E.
BALDRY, R. J.
COHEN, NATHAN.
DEACON, J. E.
FLOYD, G. P.
GIBALI, S.
GRIFFITHS, R. G. E.
GUPTA, K. L.
HELLEWELL, D.
HODGSON, M. S.
HUNT, T. W.
KORRA, K. E.
LAMBERT, C. E.
LENAERTS, J.
LOWENSTEIN-LOM, W.
MACKILLIGIN, R. G. W.
MACLACHLAN, R. I.
MCNICOL, J. C.
MARGETTS, D. R. M.
MASON, D. R.
MILLS, R. B.
MURRAY, F.
PADFIELD, R. J.
PIERCY, W. E. K.
REED, G. W.
SMITH, A.
WARDLE, Mrs. H.

Transfer to Associate Member.

FROST, J.
TAYLOR, P. A.

As Students.

CHAMBERLAIN, S.
COLLENETTE, P.
ROBINSON, F. D.
ROBINSON, M. P.
SHEASBY, G. R.
SIMPSON, G. J. H.

APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

AUGUST, 1947.

The following have applied for admission or transfer to the Institute. In accordance with the By-laws, the proposals will not be considered until the lapse of at least one month after the publication of this *Journal*, during which time any Fellow, Member, or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of the candidate.

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The names of candidates' proposers and seconders are given in parenthesis.

Applications for Membership.

ASTLEY, Robert Arthur, Mechanical Engineer, Cia Petrolera, Lobitos, Peru. (*K. M. Dobmer ; R. A. Baldry*).

BLACKMORE, David Stuart, Technical Salesman, The Shell Company of China Ltd. (*G. D. Thacker ; J. S. Jackson*).

COOPER, Harry Cyril, Manager and Chief Chemist, Messrs. Geo. Cooper & Son, Canal St. Wharf, Sheffield, 4. (*J. R. Smellie ; S. S. Bush*).

DODD, Robert Henry, Chemical Engineer, Representative of The Lummus Company, London. (*C. W. Knighton ; E. G. Thorn*).

DUTTON, Thomas Edward, Captain, R.A.S.C. (*G. Kinner ; J. W. S. Farmery*).

PAPWORTH, Sidney John, Assistant District Operator, Petroleum Board. (*H. M. Burgess ; P. I. Holmes*).

SINCLAIR, Leonard, Marketing Director, Anglo-American Oil Co. Ltd. (*C. Chilvers ; D. S. Paul*).

VICKERS, George Alexander Thomas, D/Assistant Manager, Engineering Department, Anglo-American Oil Co. Ltd. (*J. E. Jenkin ; E. Evan-Jones*).

WATSON, Edwin Sutton, Pipeline Superintendent, U.B.O.T. Ltd., Trinidad. (*J. E. Smith ; F. C. Hamilton*).

Thank you, Leonard!

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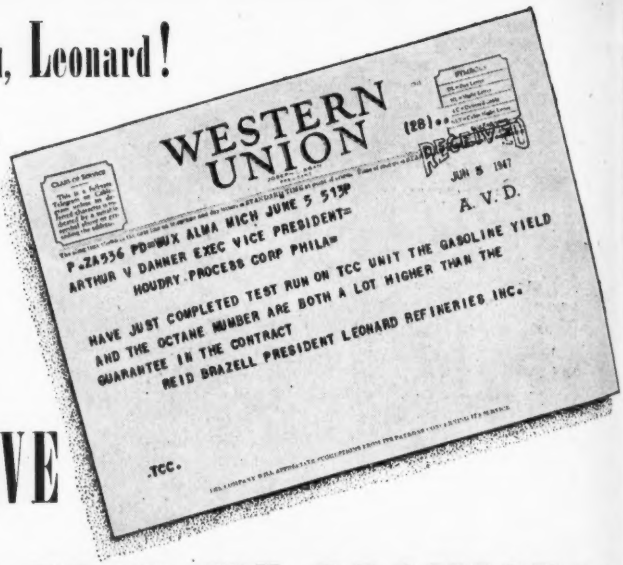
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APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

SEPTEMBER, 1947.

The following have applied for admission or transfer to the Institute. In accordance with the By-laws, the proposals will not be considered until the lapse of at least one month after the publication of this *Journal*, during which time any Fellow, Member, or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of the candidate.

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The names of candidates' proposers and seconders are given in parenthesis.

Applications for Membership.

CAMPBELL, Donald, Sales Technical Adviser, Shell Petroleum Co., Ltd. (*R. I. Lewis ; G. D. Thacker*).

CRABBE, Edward Allen, Engineer, Technical Department, Shell Co. of Straits Settlement, Singapore. (*H. W. Stevenson ; R. I. Lewis*).

DAVIES, Howard Merrett, Research Chemist, Esso European Laboratories. (*C. S. Windebank ; E. B. Evans*).

DUTTON-FORSHAW, Richard, Managing Director, Burtonwood Motor & Aircraft Engineering Co., Ltd. (*H. de Wilde ; J. Massey*).

RATCLIFFE, Douglas Henry, Operator, Anglo-Iranian Oil Co., Ltd., Abadan. (*B. D. Cauthery ; D. N. McKinlay*).

STEPHINSON, Pat Howard, Laboratory Assistant, "Shell" Refining & Marketing Co., Ltd. (*R. G. Kenzie ; D. H. Japes*).

TOWNEND, Donald Thomas Alfred, Director, British Coal Utilisation Research Association. (*W. H. Cadman ; E. J. Dunstan*).

WINTERBOTTOM, John Edward, Laboratory Assistant, "Shell" Refining & Marketing Co., Ltd. (*R. G. Kenzie ; N. Cohen*).

Transfer.

BASKIN, Leon, Prospecting Officer, Ministry of Fuel and Power. (*S. E. Coomber ; G. D. Hobson*). (*Student to Associate Member*).

DELLER, Alan William, Petroleum Marketing Assistant, Shell Petroleum Co. Ltd. (*E. L. Bass ; R. I. Lewis*). (*Student to Associate Member*).

HENRY, John, Production Superintendent, Lobitos Oilfields Ltd. (*A. T. Beazley ; C. Barrington Brown*). (*Member to Fellow*).

LE BLANC-SMITH, William Leonard, Senior Sales & Technical Representative, Vizgol Oil Refining Co., Ltd. (*S. Elliman; L. Mills*).

MCDERMOTT, Lionel Roy, Junior Exploitation Engineer, Shell de Colombia. (*Student to Associate Member*).

METCALF, Thomas John, Chemist, Lubricating & Fuel Oils Ltd. (*J. R. Smellie ; F. Dakin*). (*Associate Member to Fellow*).

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APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

OCTOBER, 1947.

The following have applied to the Institute for admission or transfer. In accordance with the By-laws, any Corporate Member may communicate by letter to the Secretary, for the confidential information of the Council, his opinion on the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading the candidate according to the class of membership.

The names of candidates' proposers and seconders are given in parenthesis.

Applications for Membership.

BILLINGHAM, William Frederick, District Manager, Petroleum Board. (*F. N. S. Evans ; J. F. F. McQueen.*)

CLARKE, Reginald Arthur, Senior Chemist, Skefko Ball Bearing Co. Ltd. (*H. W. Hutton ; P. H. Snow.*)

DAWSON, Lloyd Spurden, Technical Sales Adviser, Shell Petroleum Co. Ltd. (*R. I. Lewis ; G. D. Thacker.*)

HOLLOWAY, Francis Edward, Chief Examiner, Aeronautical Inspection Services (Air Ministry). (*J. Mason ; L. Bevan.*)

PAGET, Roger, Technical Adviser, Shell Petroleum Co. Ltd. (*R. I. Lewis ; G. D. Thacker.*)

PEARCE, Thomas Charles, Assistant Chemist, Ragosine Oil Co. Ltd. (*G. J. Vineall ; V. M. Farrant.*)

RIGBY, John Allen, Depot Superintendent, Indo-Burma Petroleum Co. Ltd., Lucknow.

SCALLAN, John Frederick Pratt, Operator, Industrial Lubricants Section, "Shell" Refining & Marketing Co. Ltd. (*C. D. Brewer ; D. Morten.*)

TYRRELL, Edward, Assistant Inspector, Fuel & Lubricants Section, Engineer-in-Chief's Dept., Admiralty. (*H. F. Jones ; W. E. J. Broom.*)

Application for Transfer.

DRYER, Stanley Raymond Collins, Assistant Chemist, Anglo-Iranian Oil Co. Ltd. (*G. T. Raine ; A. E. Hicks.*) (*Student Member to Associate Member.*)

ELECTION TO COUNCIL.

The attention of members of the Institute is directed to the following extracts from the By-Laws governing election to the Council of the Institute :—

> 72. Each and every Corporate Member may nominate in writing a Corporate Member for election as a member of Council. . . . A nomination to be valid must be signed by at least six other Corporate Members and must be received by the Secretary not later than the thirty-first day of December in any year. No member may sign more than one such Nomination Paper at any one election. . . .

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HOUDRY CATALYTIC PROCESSES

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APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

NOVEMBER, 1947.

The following have applied for admission or transfer to the Institute. In accordance with the By-laws, the proposals will not be considered until the lapse of at least one month after the publication of this *Journal*, during which time any Fellow, Member, or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of the candidate.

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The names of candidates' proposers and seconders are given in parenthesis.

Applications for Membership.

BLIGHT, Norman Bernard, Assistant Engineer, Atlantic Refining Co. of Africa.

COWLES, Melbourne Thomas, Representative, Standard Vacuum-Oil Company, London. (*H. B. Borwick ; S. J. M. Auld*).

CREAL, Norman Reginald, Acting Assistant Foreman, Agwi Petroleum Corpn. Ltd. (*F. Mayo ; K. Parsonage*).

DASHWOOD, John Horace Cassels, Army Officer on Petroleum Engineering Course at National Oil Refineries Ltd. (*T. M. Simmons ; R. B. Southall*).

EVANS, William Edward, Cost Accountant, National Oil Refineries Ltd. (*R. B. Southall ; E. S. Squire*).

FRANCIS, Edward Arthur Lionel, Army Officer on Petroleum Engineering Course at National Oil Refineries Ltd. (*T. M. Simmons ; R. B. Southall*).

GODFREE, Reginald Bruce, Research Group Leader, Esso Development Co. Ltd. (*C. S. Windebank ; E. B. Evans*).

HALL, Anthony Offley, Army Officer on Petroleum Engineering Course at National Oil Refineries Ltd. (*T. M. Simmons ; R. B. Southall*).

JONES, John William Thomas, Chemist, National Oil Refineries Ltd. (*R. B. Southall ; E. S. Squire*).

JONES, Leighton Warmington, Student, Walthamstow Technical College. (*D. Glynn Jones*).

JONES, Vincent Cadarn Reece, Laboratory Shift Supervisor, Agwi Petroleum Corpn. (*F. Mayo ; K. Parsonage*).

LENNIE, Douglas Walker, Engineer, English Drilling Equipment Co. Ltd. (*W. E. V. Abraham ; F. Walmsley*).

RECINE, Arnaldo Giovanni, Chief Executive of Lubrication School, Italy. (*G. W. D'Arcy-Evans ; G. H. Harries*).

REID, Graeme, Army Officer on Petroleum Engineering Course at National Oil Refineries Ltd. (*T. M. Simmons ; R. B. Southall*).

SHATWELL, Victor Leslie, Chief Chemist, Chiswick Products Ltd. (*W. J. Wilson ; S. T. Minchin*).

SMITH, John Charles, Demonstrator and Lecturer, Oxford University. (*F. Morton ; A. E. Dunstan*).

TANNER, Elsie May, Research Chemist, Trinidad Leaseholds Ltd. (*T. K. Hanson ; R. Sefton*).

TAYLOR, John Harold, Works Chemist, Snowdon, Sons & Co. Ltd. (*J. E. James ; E. R. Redgrove*).

THOMAS, David John, Trainee Process Foreman, Agwi Petroleum Corpn. Ltd. (*F. Mayo ; K. Parsonage*).

WILDIG, Colin Arthur, Technical Representative, Matthew Wells & Co. Ltd. (*V. H. Stott ; M. Mason*).

WILLIAMSON, Gordon McPherson, Chemist, Anglo-Iranian Oil Co. Ltd. (*D. A. Howes ; F. Gill*).

ZWICKY, Max, Chief Mechanical Engineer, Sulzer Brothers Ltd., Switzerland. (*P. Draper ; C. W. G. Martin*).

Transfer.

EVANS, Frederick Neville Stuart, District Manager, Petroleum Board. (*T. K. Hanson ; R. Sefton*). (*Associate Member to Member*).

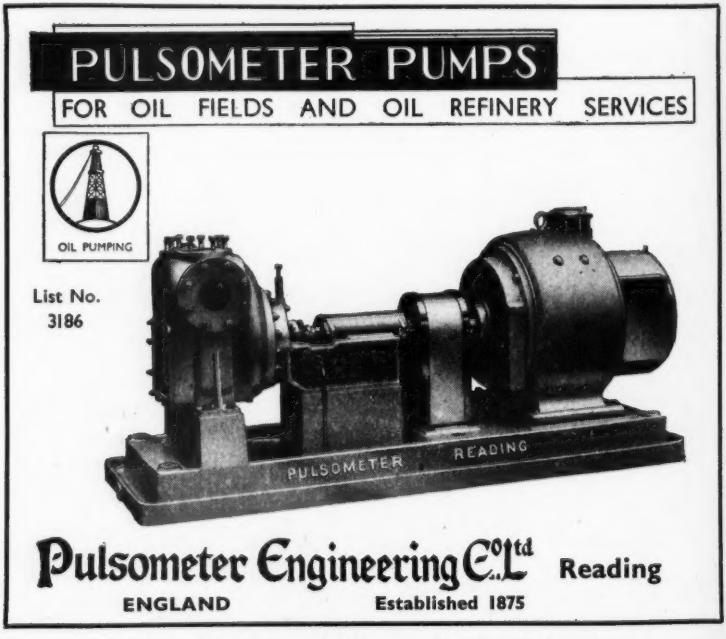
GOODFELLOW, Alfred John, Analytical Chemist, Carless, Capel & Leonard Ltd. (*R. I. Lewis ; E. Thornton*). (*Student Member to Member*).

WILSON, Alfred John, Petroleum Technician, Cities Service Oil Company. (*W. Kay ; H. Baker*). (*Associate Member to Fellow*).

ELECTION TO COUNCIL.

The attention of members of the Institute is directed to the following extracts from the By-Laws governing election to the Council of the Institute:—

> 72. Each and every Corporate Member may nominate in writing a Corporate Member for election as a Member of Council. . . . A nomination to be valid must be signed by at least six other Corporate Members and must be received by the Secretary not later than the thirty-first day of December in any year. No member may sign more than one such Nomination Paper at any one election. . . .



APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

DECEMBER, 1947.

The following have applied for admission or transfer to the Institute. In accordance with the By-laws, the proposals will not be considered until the lapse of at least one month after the publication of this *Journal*, during which time any Fellow, Member, or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of the candidate.

The object of this information is to assist the Council in grading the candidate according to the class of membership.

The names of candidates' proposers and seconders are given in parenthesis.

Applications for Membership.

ANDREWS, Douglas, Petroleum & Explosives Inspector, London County Council. (*J. A. Ainsworth ; S. G. Burgess*).

BANDFIELD, Charles Alfred, Chief Engineer, The Woodfield Hoisting & Manufacturing Co., Ltd. (*H. de Wilde ; H. J. Wilkinson*).

BUCK, Frank Raymond, Research Chemist, Trinidad Leaseholds Ltd. (*F. Morton ; T. K. Hanson*).

BURGESS, James Rawson, Lieut.-Colonel, A.D.S.T. (Petroleum Engineering). (*O. A. Bell ; D. S. Pidgeon*).

COATS, Wilfred Lennox, Engineer, The Petroleum Board. (*H. Hyams ; F. Tipler*).

DRURY, Gordon Newton, Deputy Assistant Director of Supplies & Transport, The War Office. (*O. A. Bell ; H. F. Jones*).

ENGEL, Stefan, Petroleum Engineer, Polish Resettlement Corps. (*S. Sulimirski ; R. K. Oswald*).

GIBSON, Peter Douglas, Technical Lecturer, Shell-Mex and B.P. Ltd. (*F. N. Harrap ; G. L. Coles*).

GRIFFITHS, Thomas Haydn, Apprentice Fitter and Turner, National Oil Refineries Ltd. (*R. B. Southall ; E. Thornton*).

HOGARTH, William Gloag, Secretary and Chief Accountant, Eagle Oil & Shipping Co. Ltd. (*R. G. Mitchell ; R. I. Lewis*).

JACKSON, Charles Frederick, Chemist, Shell Petroleum Co. Ltd. (*R. I. Lewis ; H. W. Stevenson*).

KENNEDY, Gordon Telford, Research Chemist, Trinidad Leaseholds Ltd. (*F. Morton ; T. F. Brown*).

MERRICK, Cecil Morriss, Managing Director, Shell-Mex and B.P. Ltd. (*J. A. Oriel ; G. H. Coxon*).

OKE, Eric Percy Cooper, Assistant Chemist, Anglo-Iranian Oil Co. Ltd. (*P. Docksey ; D. A. Howes*).

PALMER, John Simpson, Student, Chemical Engineering, Birmingham University. (*F. H. Garner*).

PLATT, James Westlake, Managing Director, Eagle Oil & Shipping Co. Ltd. (*R. G. Mitchell ; R. I. Lewis*).

PLOWMAN, Henry Lush, Works Chemist, T. H. Newsome & Co. Ltd. (*E. G. Ellis ; V. M. Farrant*).

POHL, Wilfred, Chemist, "Shell" Refining & Marketing Co. Ltd. (*N. L. Anfilogoff ; W. R. P. Hodgson*).

RICHARDS, Thomas Charles, Development Chemist, National Oil Refineries Ltd. (*R. B. Southall ; J. A. Green*).

RINTOUL, Charles Jeffrey Vere, Student, Chemical Engineering, Birmingham University. (*F. H. Garner*).

ROBERTS, David Lewis, Senior Laboratory Assistant, "Shell" Refining & Marketing Co. Ltd. (*R. G. Kenzie ; N. Cohen*).

SANSOM, Henry William, Manager of Shipping Dept., Eagle Oil & Shipping Co. Ltd. (*R. I. Lewis ; H. N. Short*).

SCRIVEN, Arthur Edward, Manager, Sales Division, Eagle Oil & Shipping Co. Ltd. (*R. G. Mitchell ; S. Hunn*).

SINGH, Narain, Sales Engineer, Caltex (India) Ltd., Bombay.

STREET, Ralph Hope, Chief Technical Officer, Shell Company of Australia Ltd. (*R. I. Lewis ; H. Hyams*).

THORLEY, Brian, Student, Birmingham University. (*F. H. Garner*).

TRAWFORD, Alfred John, Laboratory Assistant, Lobitos Oilfields Ltd. (*V. Biske ; W. A. Mitchell*).

WALMSLEY, Peter James, Student, Oil Technology, Royal School of Mines. (*V. C. Illing*).

Transfer.

HAZZARD, Geoffrey Francis, Chief Chemist, "Shell" Refining & Marketing Co. Ltd., Shell Haven. (*F. Morton ; F. Mackley*). (*Member to Fellow*).

NEW MEMBERS.

The following elections have been made by the Council in accordance with the By-Laws.

Elections are subject to confirmation in accordance with the By-Laws.

As Members.

BRANCH, A. C.
DUTTON-FORSHAW, R.
NASH, R. L.
POLLOCK, J. L. N.
ROCKE, H. W.
SINCLAIR, L.
VEULLE, P. M. DE

Transfer to Member.

BLANC-SMITH, W. L. LE
SIMKINS, C. R. P.

As Fellows.

BAGNOLD, R. A.
BIRD, T. R.
BLUNDELL, L. W.
BOOTMAN, E. J.
DAWSON, L. S.
GILL, F.
HILL, J. I.
RAIGORODSKY, P. M.
TOWNEND, D. T. A.

Transfer to Fellow.

CLEGG, N. A.
CRAGG, J. C.
HENRY, J.
LEVIS, R.

As Associate Members.

BARNES, K. J. U.
BLACKMORE, D. S.
BOX, J. S.
BROOKS, F. L.
BURNINGHAM, J.
CAIRD, K. C.
CHARLTON, D. C.
COOPER, H. C.
GERSHON, J. C.
GOVINDAKRISHNAYYA, P.
MANLY, F. C.
PAPWORTH, S. J.
PRESTON, F. C.
WATKINS, F. F. C.

Transfer to Associate Member.

BASKIN, L.
DELLER, A. W.
LEHNER, H. P. E.

As Associate Fellows.

ASTLEY, R. A.
CAMPBELL, D.
CRABBE, E. A.
CRAWSHAW, S. J.
DAVIES, H. M.
DEEN, A. N. EL
DODD, R. H.
EL-SHERIF, I. M. I.
LEACH, R. F.
MURRAY, G. F. J.
RATCLIFFE, D. H.
ROMASZKAN, K. J.
SCHMEIDLER, J.
VICKERS, G. A. T.
WATSON E. S.

Transfer to Associate Fellows.

BRUNNER, D. G.
GEORGE, H. R.
MCDERMOTT, L. R.

As Student Members.

BILTON, N. F.
CULLINGHAM, E. K.
DAVIES, W. D.
DUTTON, T. E.
GARDE-HANSON, H.
MEHTA, R. S.
SELWOOD, P.
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LIST OF ADVERTISERS

	PAGE
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PROGRAMME OF MEETINGS 1947-1948

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THE INSTITUTE OF PETROLEUM

Meetings 1947-48

All meetings will be held at Manson House, 26, Portland Place, London, W.1, at 5.30 p.m. on the dates stated. Visitors are welcome. Tea and light refreshments will be provided at 5 p.m.

1947	
October 8	"Metallurgical Methods for Combating Corrosion and Abrasion in the Petroleum Industry." B. B. Morton.
November 12	"Rheological Investigation of Asphaltic Bitumen in Connexion with its Technical Applications." R. N. J. Saal.
December 10	"Examination of used Engine Lubricating Oils." K. Hilfreich, J. C. McNicol and L. Rosenfeld.
1948	
January 14	"Polythene." J. C. Swallow.

1948 February 11	"Aerial Photography and Exploration for Oil." Dr. Ir. N. J. M. Taverne.
March 10	"The Production of Oil from the Fields of South-West Iran." H. S. Gibson, C.B.E., M.A., F. Inst. Pet.
April 14	"Properties of Paraffin Wax as an Effect of Composition." S. T. Minchin, B.Sc., A.R.I.C., F. Inst. Pet.
May 12	"The Chemical Evaluation of Oils of Medium Viscosity." C. H. Johnson, Ph.D. (Lond.), D.Sc. (Lond.), M. Inst. Pet.
June 9	Subject to be announced.

Whenever possible limited numbers of preprints of papers to be read will be available prior to each meeting and members wishing to receive a copy should apply to the Secretary of the Institute.

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THE INSTITUTE OF PETROLEUM

ABBREVIATIONS (TENTATIVE)

THE Abstracts Sub-Committee of the Publications Committee of the Institute has given consideration to the abbreviations to be used not only in the Abstract Section of the *Journal* but also in the Transactions Section and in other publications of the Institute.

The abbreviations listed below are for the time being of a tentative character and comments are requested. These comments should reach the Institute before November 30, 1947, in order that an agreed list may be published and put into general use without undue delay.

As far as possible these abbreviations are in agreement with those laid down by the British Standards Institution in B.S. 560: 1934 "Engineering Symbols and Abbreviations" as amended in September 1945 and in B.S. 813: 1938 "Chemical Symbols and Abbreviations." It has, however, been found necessary in some cases to depart from these standards on account of long usage of a particular abbreviation in the Petroleum Industry. It is realized that for some technical terms there are a variety of abbreviations in use. In such cases the Sub-Committee has selected the abbreviation considered to be the one most widely used.

Special reference should be made to the September 1945 amendment of B.S. 560 in so far as it concerns the omission of the full stop. The ruling is:—

> Full stops shall be omitted in all cases of single-word abbreviations relating to units and quantities, except where doubt may exist as to whether the letters given represent a complete word or an abbreviation.
>
> Examples: cm ft lb
>
> Full stops shall be used with abbreviations representing more than one word:
>
> Examples: A.C. b.h.p.
>
> The full stop shall be omitted before a solidus.

Abbreviations should not be used, especially in complete articles, unless it is certain that the meaning of the abbreviation is obvious and not ambiguous. Where it is desired to use a new or little-known abbreviation to avoid frequent repetition of a long word or phrase, the author should in the first place use the full term and place the abbreviation within parentheses, thus:

Poly*iso*butylene (P.I.B.)

Subsequent references in the paper would be by the abbreviation.

Term	*Abbreviation*	*Term*	*Abbreviation*
About	*ca*	British Patent	B.P.
Absolute	abs	British Pharmacopoeia	B.P.
Absolute alcohol	abs. alc.	British Standards	B.S.
Acceleration	acc	British Standards Institution	B.S.I.
Acceleration due to gravity	*g*	British Standard Specification	B.S.S.
Alcoholic	alc	British thermal unit	B.Th.U.
Alkaline	alk	Bromine number	Br. No.
Alternating current	A.C.	Calculated	calc
American Petroleum Institute	A.P.I.	Calorie	g.cal
American Society for Testing Materials	A.S.T.M.	Calorie (kilo-calorie)	k.cal
Ampère	amp	Calorific value	cal. val.
Ampère-hour	amp.-hr.	Candle-power	c.p.
Analytical standard of purity (analytical reagent)	A.R.	Carbon residue (Conradson)	C.R. (Conr).
Ångstrom unit	Å	Carbon residue (Ramsbottom)	C.R. (Rams).
Anhydrous	anhyd	Catalyst (tic) (tical)	cat
Aniline point	an. pt.	Centigrade (degree)	°C
Approximate (ly)	approx or *ca*	Centigrade heat unit	C.H.U.
Aqua regia	aq. reg.	Centimetre	cm
Aqueous	aq	Centimetre-gram-second	C.G.S.
Assessor	assr	Centi-normal	0·01N
Asymmetric (as used in organic chemistry)	*as*	Centipoise	cp
Atmosphere (s) (ic)	atm	Centistokes	cs
Atomic weight	at. wt.	Centre of gravity	C.G.
Barometer (ric)	bar	Centrifugal	centf
Barrel	brl	Cetane number	Cetane No.
Barrels per day	b.d.	CFR Motor Method	CFR. MM.
Barrels per stream day	b.s.d.	CFR Research Method	CFR. RM.
Beaumé	Bé	Circa	*ca*
Birmingham gauge	B.G.	Chemical (ly)	chem
Board of Trade	B.o.T.	Cleveland	Clev
Boiling point	b.p.	Cloud point	cl. pt.
Bottom settlings and water	B.S. & W.	Coefficient	coeff
Brake horse-power	b.h.p.	Colour	col
Brake mean effective pressure	b.m.e.p.	Commercial	coml
		Compare	cf
		Compression ignition	C.I.

Term	*Abbreviation*	*Term*	*Abbreviation*
Compression pressure	C.P.*	Decinormal	0·1N
Compression ratio	C.R.	Demulsification number	demuls. No.
Concentrated	conc	Density (followed by temperature of measurement as a subscript)	d
Concentrated oil of vitriol	C.O.V.	Dextro-rotatory	*d*-
Concentration	concn	Diameter	dia
Congealing point	con. pt.	Diesel engine road vehicle	D.E.R.V.
Constant	const	Diesel index	D.I.
Constant boiling mixture	C.B.M.	Di-*iso*butylene	D.I.B.
Constant pressure cycle	c.p. cycle	Dilute	dil
Constant volume cycle	c.v. cycle	Diphenyl-dichloro-tri-chlorethane	D.D.T.
Content (*e.g.*, Wax content)	cont	Direct current	D.C.
Co-operative fuel research	C.F.R.	Distil, etc.	dist
Co-ordinating Research Council	C.R.C.	Dozen	doz
Corrected	corr	Drill-stem test	D.S.T.
Coulomb	C	Ductility	duct
Cracked	cr	Effective horsepower	e.h.p.
Critical	crit	Efficiency	eff
Critical temperature	crit. temp.	Electric	elec
Critical pressure	crit. press.	Electromagnetic unit	e.m.u.
Crystalline	cryst	Electromotive force	e.m.f.
Cubic	cu	Electron-volt	e.v.
Cubic centimetre	cc or cm^3	Electrostatic unit	e.s.u.
Cubic feet per second	cusec or cu. ft. p.	End-point	E.P.
		Eötvos unit	E.U.
Cubic foot	cu. ft.	Engler degree	°E
Cubic inch	cu. in.	Equivalent	equiv
Cubic meter	cu. m.	Equivalent theoretical plate	E.T.P.
Cubic yard	cu. yd.	Etcetera	etc
Cycles per minute	c.p.m.	Et sequentes	*et. seq.*
Cycles per second	c.p.s.	External	ext
Cylinder	cyl	Extrapolate, etc.	extrap
Darcy	D	Extreme pressure	E.P.
Decimetre	dm	Fahrenheit (degree)	°F
Decompose, etc.	decomp	Farad	F
Debye Unit	D	Feet per minute	f.p.m.

* This is also used in American literature to mean "Chemically pure".

Term	*Abbreviation*
Feet per second	f.p.s.
Figure	Fig.
Final boiling point	F.B.P.
Flash Point	fl. pt.
Foot	ft
Foot-pound-second	F.P.S.
For example	*e.g.*
Freezing point	f.p.
French patent	Fr.P.
Gallon	gal
Gallons per day	g.p.d.
Gallons per hour	g.p.h.
Gallons per minute	g.p.m.
Gamma	γ
Gauge	ga
Genus	gen
German patent	D.R.P.
Grain	gr
Gram	g
Gram-molecule	mol
Heat transfer co-efficient	H.T.C.
Henry	H
Height	ht
Height of equivalent theoretical plate	H.E.T.P.
Highest useful compression ratio	H.U.C.R.
Horizontal directing tendency	H.D.T.
Horse-power	h.p.
Horse-power hour	h.p.hr.
Hour	hr
Hundredweight	cwt
Hydrogen-ion concentration	[H·]
Hydrogen-ion (concentration logarithm)	pH
Imperial	Imp
Imperial gallon	I.G.
Inactive (organic chemistry)	*i-*
Inch	in
Indicated horse-power	i.h.p.
Indicated mean effective pressure	i.m.e.p.
Industrial methylated spirit	I.M.S.
Initial boiling point	I.B.P.
Inorganic	inorg
Insoluble	insol
Institute of Mining and Metallurgy	I.M.M.
Institute of Petroleum	I.P.
Internal	int
Internal combustion	I.C.
International Critical Tables	I.C.T.
Interpolate	interp
Joule	J
Kerosine	kero
Kilo-	k
Kilocycles per second	kc/s
Kilogram	kg
Kilometre	km
Kilovolt	kV
Kilovolt Ampère	kVA
Kilowatt	kW
Kinematic	kin
Kinematic viscosity	kin.visc
Laevo-rotatory	*l-*
Latent heat	lat. ht.
Liquid	liq
Long-time burning oil	L.T.B.O.
Lovibond (colour)	Lov
Lubricating oil	lub. oil
Maximum	max
Mean effective pressure	m.e.p.
Mega- or Meg-	M
Melting point	m.p.
Meta-	*m-*
Methyl ethyl ketone	M.E.K.

Term	*Abbreviation*
Metre	m
Micro	μ
Micron	μ
Miles per gallon	m.p.g.
Miles per hour	m.p.h.
Milliampère	mA
Millidarcy	mD
Milligal	mG
Milligram	mg
Millilitre	ml
Millimetre	mm
Millimetres of mercury	mm. Hg.
Millimicron	mμ
Minimum	min
Minute	min
Miscellaneous	misc
Molar (concentration)	M
Molecule, etc.	mol
Molecular weight	mol. wt.
Namely	viz
National Advisory Committee for Aeronautics	N.A.C.A.
National Physical Laboratory	N.P.L.
Natural Gasoline Association of America	N.G.A.A.
Naval Boiler and Turbine Laboratory	N.B.T.L.
Negative	neg
Neutralization number	neut. No.
Neutralization value	neut. val.
Nominal horse-power	n.h.p.
Normal (concentration)	N or 0·1N
Normal (structure of organic compounds)	*n*-
Normal temperature and pressure	N.T.P.
Number	No.
Octane number	O.N.
Official test insecticide	O.T.I.
Ohm	Ω
Once-run distillate	O.R.D.
Organic	org
Ortho-	*o*-
Ounce	oz
Overproof	o.p.
Oxidation	oxidn
Para-	*p*-
Parts per 100,000	p.p. 100,000
Parts per million	p.p.m.
Penetration	pen
Pensky-Martens	P.M.
Per annum	p.a.
Petroleum	pet
Positive	pos
Potential difference	p.d.
Pound	lb
Pounds per square inch	p.s.i.
Pounds per square inch absolute	p.s.i.a.
Power factor	p.f.
Precipitate	ppt
Precipitating	pptg
Precipitated	pptd
Precipitation	pptn
Pressure (water gauge)	w.g.
Pressure distillate	P.D.
Pump horse-power	p.h.p.
Qualitative	qual
Quantitative	quant
Quart	qt
Quarter (28 pounds)	qr
Quod vide	*q.v.*
Racemic	*r*-
Recrystallized	recryst
Redwood I (or II)	Red. I (or II)

Term	*Abbreviation*
Reflux ratio	R.F.R.
Refractive index (with subscript)	*n*
Reid vapour pressure	R.V.P.
Revolutions per minute	r.p.m.
Revolutions per second	r.p.s.
Ring and Ball	R. & B.
Room or ordinary temperature	room temp
Root mean square	r.m.s.
Saponification number	sap. No.
Saponification value	sap.val.
Second	sec
Seconds Saybolt Furol	S.S.F.
Seconds Saybolt Universal	S.S.U.
Secondary	*sec-*
Setting point	set. pt.
Shaft horse-power	s.h.p.
Society of Automotive Engineers	S.A.E.
Softening point	soft. pt.
Soluble	sol
Special boiling point spirit	S.B.P.
Species novo	sp. nov.
Specific	sp
Specific gravity	sp. gr.
Specific heat	sp. ht.
Specific refaction	sp. ref.
Specific volume	sp. vol.
Specification	spec
Spontaneous ignition temperature	S.I.T.
Square	sq
Square centimeter	sq. cm. or cm^2
Square foot	sq. ft.
Square inch	sq.in.
Square yard	sq.yd.
Standard Inspection Laboratory	S.I.L.
Standard temperature and pressure	S.T.P.
Standard wire gauge	s.w.g.
Standardization of Tar Products Tests Committee	S.T.P.T.C.
Steam emulsion number	S.E.No.
Straight-run	S.R.
Symmetrical (organic chemistry)	*sym-*
Technical	tech
Temperature	temp
Tertiary (organic chemistry)	*tert-*
Tetra-ethyl lead	T.E.L.
That is	*i.e.*
Thousands of cubic feet (in gas measurement)	M.c.f.
Threads:	
American Petroleum Institute	A.P.I.
British Association	B.A.
British Standard Fine	B.S.F.
British Standard Pipe	B.S.P.
British Standard Whitworth	B.S.W.
Threads per inch	t.p.i.
Top, middle, and bottom	T.M.B.
Tractor vaporizing oil	T.V.O.
True boiling point	T.B.P.
Twaddell	Tw
Ultra-violet	U.V.
Under proof	u.p.

Term	*Abbreviation*	*Term*	*Abbreviation*
United States gallon	U.S.G.	Viscosity gravity constant	V.G.C.
United States Patent	U.S.P.	Viscosity index	V.I.
United States Pharmacopoeia	U.S.P.	Volt	V
Vacuum	vac	Volume	vol
Value	val	Water and sediment	W. & S.
Vapour pressure	v.p.	Watt	W
Viscosity	visc	Weight	wt
Viscosity (absolute)	abs. visc.	Yard	yd
Viscosity (kinematic)	kin. visc.		

SYMBOLS.

Plus	+	Not greater than	$\ngtr$
Minus	−	Less than	<
Plus or minus	±	Not less than	$\nless$
Equals	=	Per	/
Equivalent to or identical with	≡	Per cent	%
Not equal to	≠	Degree	°
Greater than	>	Proportional to	∝

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Vol. 33 DECEMBER 1947 No. 288

CONTENTS

	PAGE
The Alkylation of *iso*Paraffins with Olefins in the Presence of Sulphuric Acid. Part I. The Composition of an Aviation Alkylate. By Frank Morton and Alan R. Richards	697
Aluminium Stearate Gels for use as Flame-Thrower Fuels. By C. M. Cawley, J. H. G. Carlile, J. G. King, and F. E. T. Kingman	721
Indexes to Transactions, Vol. 33. Author	756
Name	759
Subject	762
Abstracts	421A
Book Review	463A
Books Received	464A
Indexes to Abstracts, Vol. 33. Authors	465A
Subject	474A
Institute Notes	i–iii

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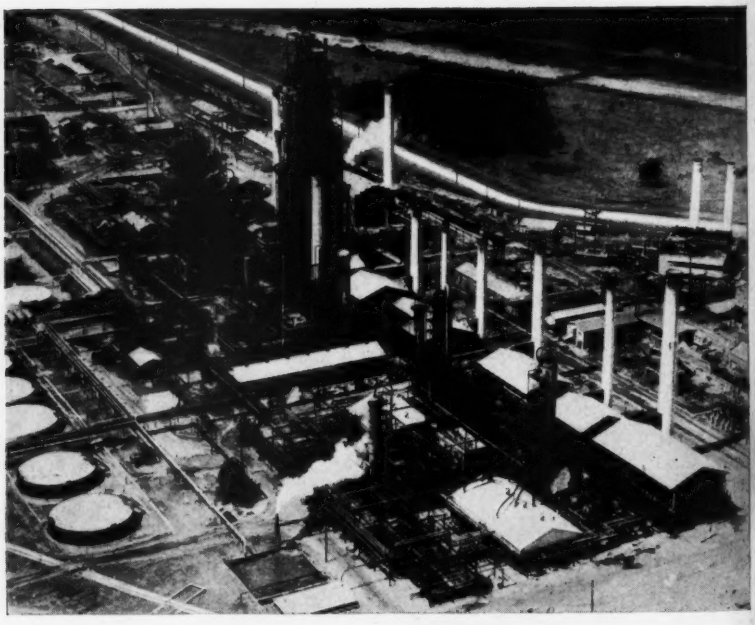

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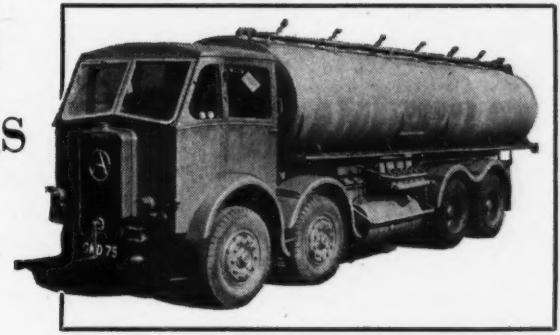

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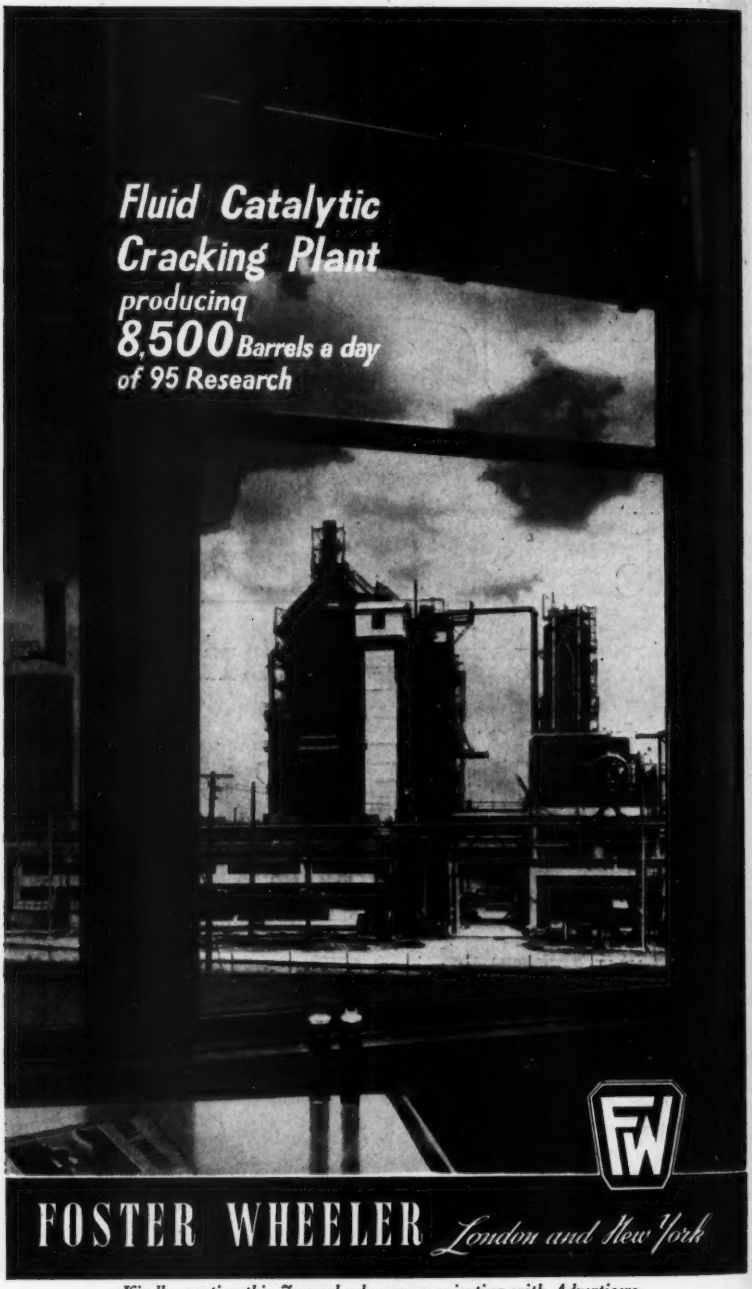
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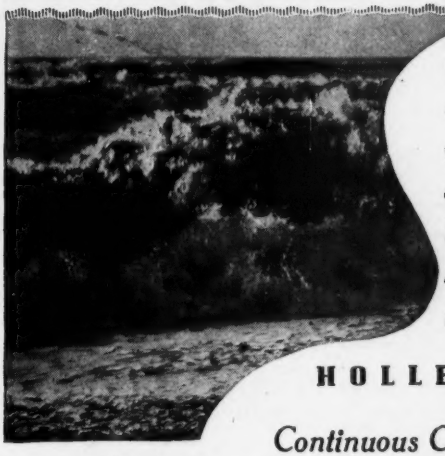

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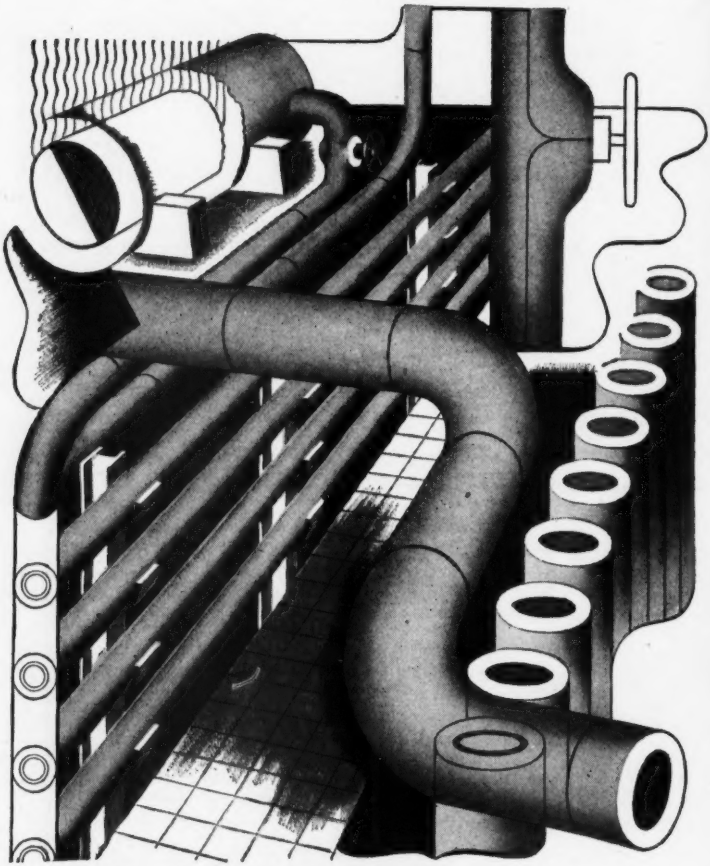

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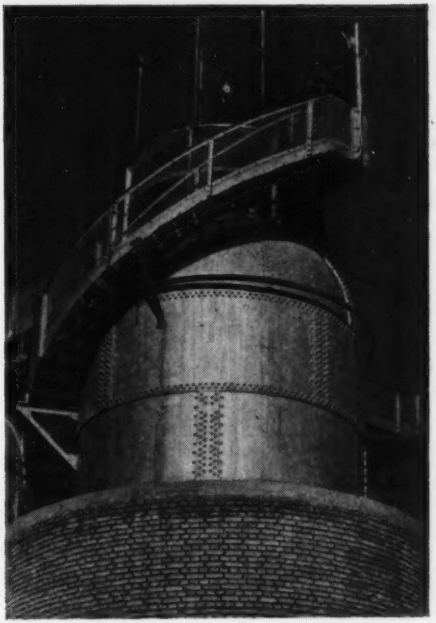

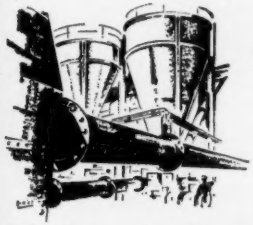

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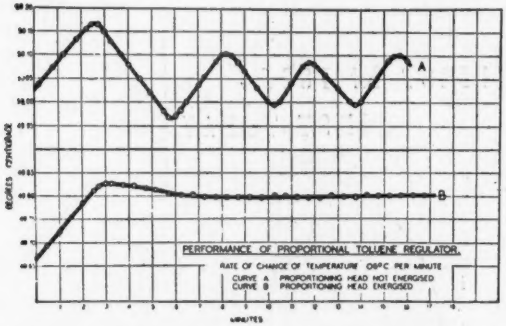

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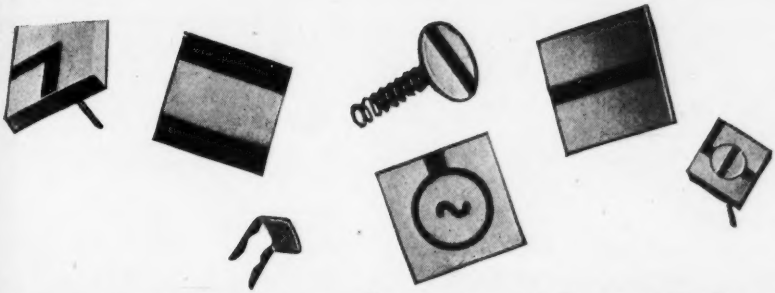

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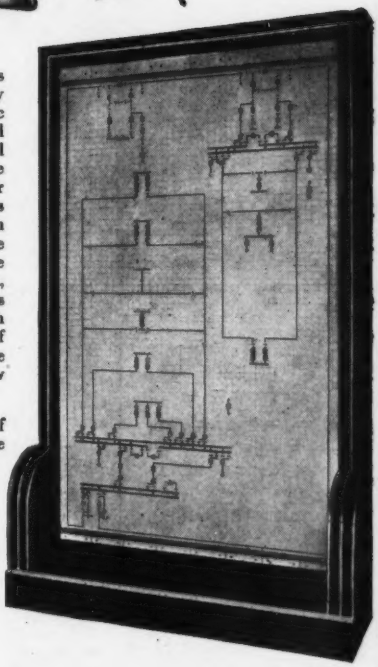

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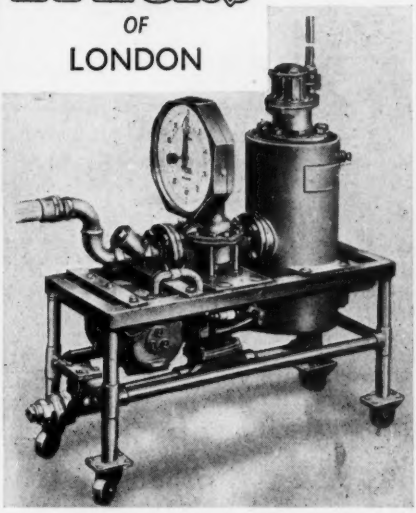

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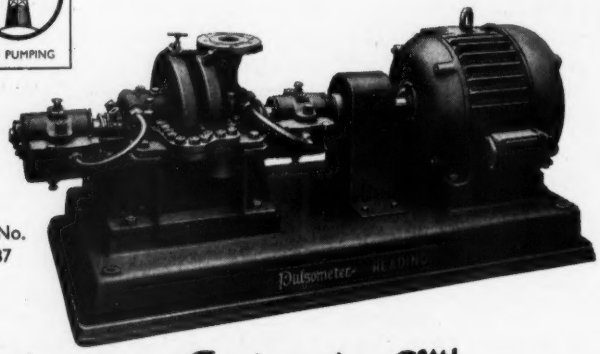

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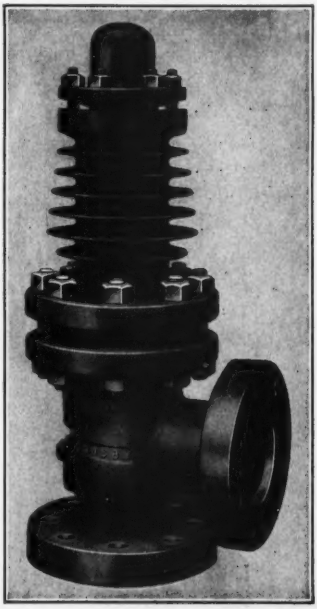

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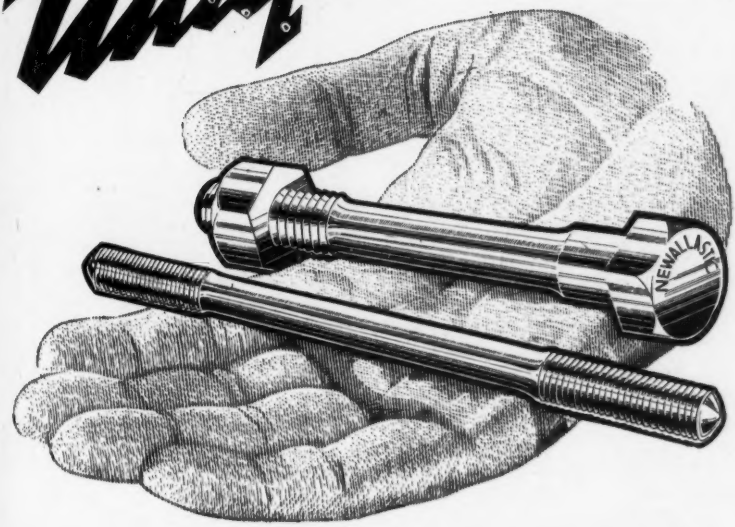

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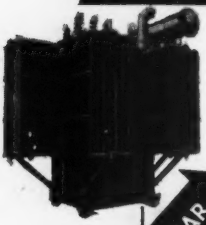

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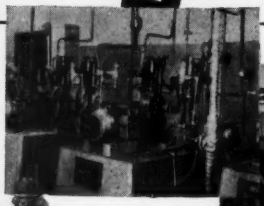

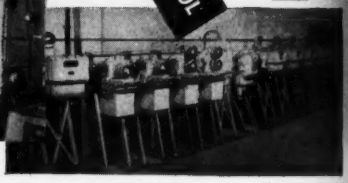

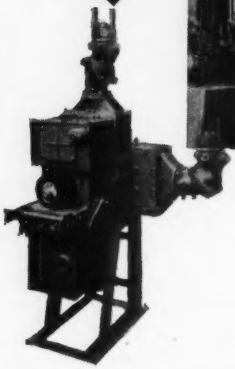

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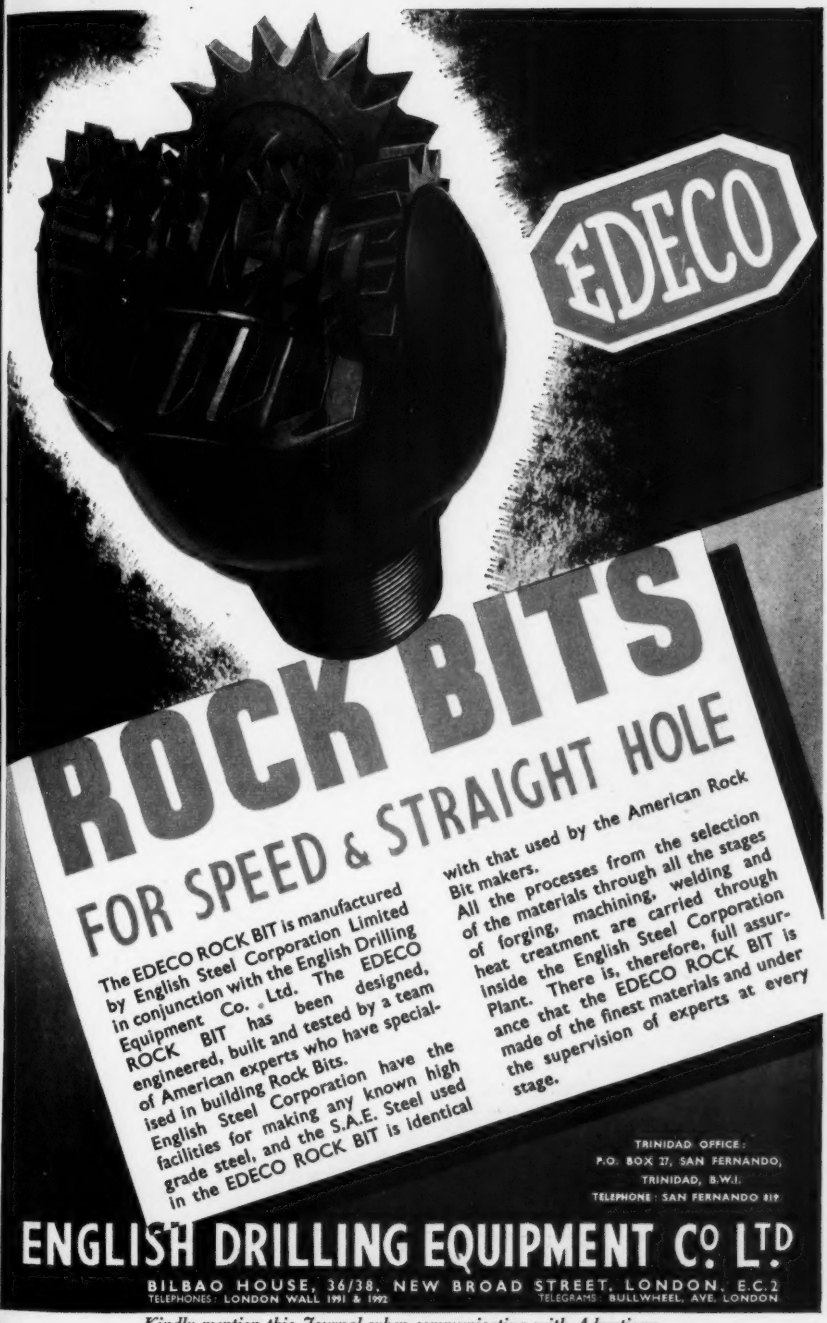
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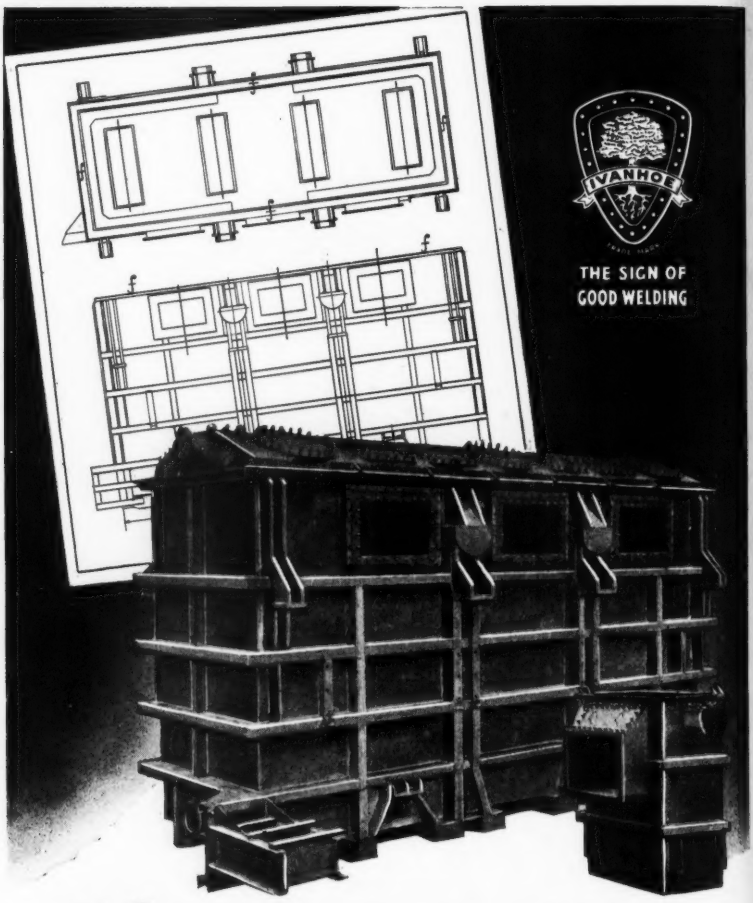

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not only in money, but in man-hours!

In catalytic cracking, it's the over-all on-stream efficiency that counts. And that depends not only on long runs but on short down time for turn-around.

One Houdry licensee recently turned around two TCC units with an expenditure of only 16,000 man-hours. Another turned around two units with 25,000 man-hours. A third turned around a single TCC unit with only 9,700 man-hours. The on-stream periods of these five units had averaged better than 200 days. They were turned around with an expenditure of less than one man-hour per barrel of through-put!

These are typical—not extraordinary—examples of how TCC's basic simplicity of design pays off in minimum maintenance. Its shorter turn-around time saves money and man-hours. This is of particular advantage in refining operations of relatively small size, where a single catalytic unit is the only source of high-quality fuel. It is easy for such a refiner to build up, in advance of turn-around, a sufficient backlog of catalytic motor fuel to keep him in production throughout the brief turn-around period.

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